slowly and therefore intermediate between types A and B.

Some important physical and meteorological significance must be attached to the indraft of air to points in front of the center and not to the center itself. The trajectories representing the inflowing air may be continued, in the particular case referred to, for distances beyond the region of circular isobars, and it would therefore appear that these strong currents are not primarily due to the previous existence of a center of disturbance, but to some more dominant cause which directs their trajectories to points successively approached by the center of circulation. It may be noticed that the direction of motion of the center with regard to the motion of these dominant winds stands in the relation of west to southwest or of southwest to south, and possibly the inblowing wind may be the determining cause of the motion of the barometric minimum.

The details of the storm of February 26–27, 1903, for which the trajectories were drawn are given in a paper read before the Royal Meteorological Society on June 17, 1903.

THE METEOROLOGICAL WORK OF THE EXPEDITION TO THE BAHAMAS.[1]

By Dr. O. L. Fassig, Section Director.

Leaving Baltimore June 1 on the two-masted schooner *W. H. Van Name*, with the scientific expedition sent out under the auspices of the Baltimore Geographical Society, I arrived at Nassau, Bahama Islands, on June 17. Storms, calms, and head winds marked the entire voyage outward, making it difficult to secure reliable instrumental records of the weather and temperature of the water. However, some interesting results were obtained which will be discussed in a separate report. Arriving at Nassau, a thermograph, barograph, hydrograph, and pluviograph were installed at the cable office by the courtesy of Mr. P. H. Burns, superintendent of the Bahamas cable. Mr. Burns also kindly attended to these self-recording instruments during my absence from Nassau, enabling me to obtain continuous records of the temperature, pressure, humidity, and time of occurrence of rain for a period of about thirty days, from June 20 to July 20. From the colonial records I had copied the monthly and annual mean values of meteorological observations for a period of five years.

During my short stay of two weeks at Nassau I succeeded in obtaining some interesting records of temperature, pressure, and humidity of the upper atmosphere by means of the Weather Bureau kite equipment, which I hope will also prove to be of some value in defining the vertical rate of change in atmospheric conditions in these latitudes. Light winds are the rule in the islands during the summer months, and it was only on a few occasions that favorable opportunities were presented for flying kites. However, five ascents were made to elevations varying from 3500 to approximately 8000 feet. The highest elevation was attained by the use of a launch. Steaming into the wind we were enabled to obtain a somewhat increased wind velocity. Apparently the wind velocity decreases rapidly after an elevation of 5000 to 6000 feet, it being difficult to detect any motion in the clouds above the lower cumulus layer. The results will be discussed at the earliest opportunity.

On the return trip, which was made under more favorable conditions than the outward voyage, an interesting series of observations of water temperatures was made from Nassau to Baltimore. While passing through the Gulf Stream the temperature of the water was noted every half hour or oftener. Good records were also obtained by means of the thermograph, barograph, and hydrograph.

In addition to the meteorological duties noted above, a magnetic survey of the islands was made. Declination, dip, and relative intensity were measured on the islands of New Providence, Hog, Watlings, Long, and Abaco. Observations made in past years in these islands included only the element of declination. A self-registering tide gage was also installed by me. The magnetic instruments and tide gage are the property of the United States Coast and Geodetic Survey.

The generous cooperation of the Weather Bureau with the Baltimore Geographical Society has been greatly appreciated by the director of the expedition, and due acknowledgments will be made in the official publications of the results of the expedition.

[1] Under date of August 1, Dr. O. L. Fassig reports his return to Baltimore from the Bahama Island, and gives some idea of the work accomplished.

CLIMATOLOGY OF COSTA RICA.

Communicated by Mr. H. PITTIER, Director, Physical Geographic Institute.

[For tables see the last page of this REVIEW preceding the charts.]

Notes on the weather.—On the Pacific slope the rain was uncommonly scarce, the month showing regular alternations of short periods of two, three, and four days of drought, separated by others of one and two days with moderate rainfall. On the 25th the rain began falling daily and the 28th, 29th, and 31st were marked by heavy showers. In San José, pressure and temperature were about normal, and the relative humidity a little less than the mean. Sunshine, 144 hours against a normal of 119. On the Atlantic slope also there was a scarcity of rain, excepting at a few stations at the foot of the Cordillera and at Turrialba and Paraiso in the Reventagon Valley, where the fall showed an excess. On July 10 a cyclone crossed the plains of Sta. Clara in an E–W direction, causing much damage to the banana plantations.

Notes on earthquakes.—July 23, 7h 20m a. m., slight shock NW–SE, intensity II, duration 3 seconds.

OBSERVATIONS OF SOLAR RADIATION WITH THE ANGSTROM PYRHELIOMETER AT ASHEVILLE AND BLACK MOUNTAIN, N. C.

By Mr. H. H. KIMBALL, Assistant Editor, Monthly Weather Review, dated July, 1903.

The Ångström compensating pyrheliometer, No. 28, used by Davis and Pierce[1] at Providence, R. I., from November, 1901, to September, 1902, was installed by me at Asheville, N. C., on November 8, 1902, in accordance with instructions received from the Chief of Weather Bureau. The point selected for its exposure was on the lawn just south of the Ravenscroft Hotel, near the crest of a ridge running north and south, with a slight dip to the south. The business portion of the town lay to the north and east, and as soft coal was almost the only fuel used the smoke at times became quite dense, particularly with light northerly winds.

The arrangement of circuits was as described by Professor Marvin in the MONTHLY WEATHER REVIEW for October, 1901, Vol. XXIX, p. 456. At first the galvanometer was suspended from the south side of the trunk of a large and nearly branchless locust tree, instead of from the tripod, as shown in fig. 1. Here an unobstructed view of the sun was had from the time it appeared above Beaumont Mountain, about a mile distant, some fifteen minutes after the time of true sunrise, until it set behind mountains nearly 20 miles distant, the tops of which were only one or two degrees above the true horizon. Winds above 20 miles per hour caused such annoying oscillations in the galvanometer that on December 22 it was moved to a post at the southeast corner of the hotel porch, where it was well protected from the prevailing northwest winds; but at noon and again at 4 p. m. the tripod support of the pyrheliometer had to be moved a few feet to avoid the shadow of shade trees.

On December 2, a Pickering polarimeter[2] loaned by Prof. E.

[1] See Monthly Weather Review for June, 1903, p. 275.

[2] For a description of this instrument see Proc. Amer. Acad. of Arts and Sci. N. S. Vol. XIII. Pp. 294–302.

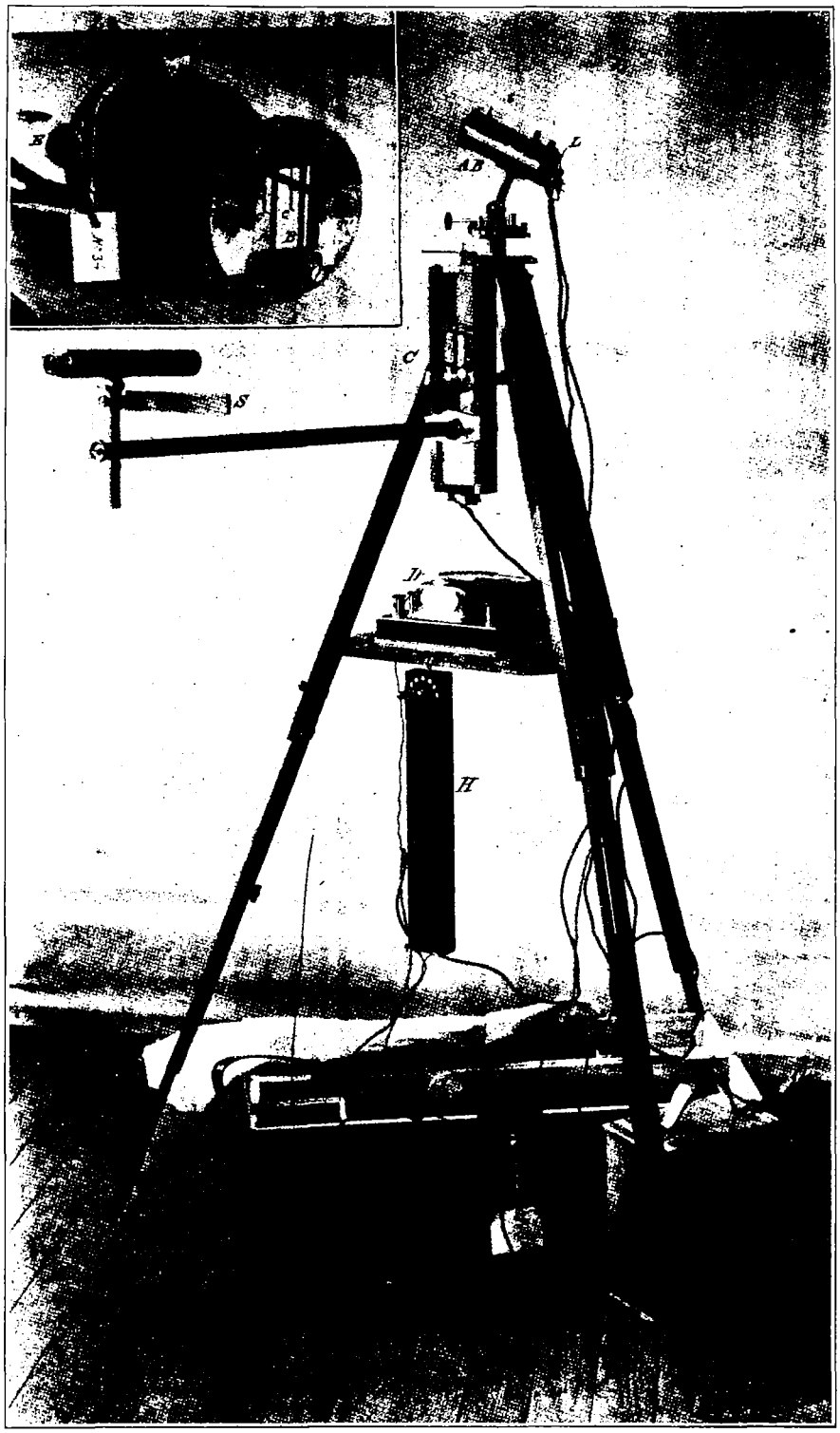

FIG. 1.—Ångström's portable electrical compensating pyrheliometer.

C. Pickering, was installed on the lawn, and proved to be admirably adapted for measuring the polarization of blue sky light; the altazimuth mounting was crude and the position of the sun could not be determined closer than to within half a degree in azimuth and altitude; the pointing of the telescope was liable to be disturbed during an observation, since the vertical circle could not be clamped.

Wishing, if possible, to obtain observations unaffected by smoke, the instruments were, on February 16, 1903, removed to Black Mountain, N. C., about 16 miles east of Asheville, and there installed in an open field surrounded by forest trees, back of which were mountain ranges from 2 to 7 miles distant, in all directions except west. The only smoke of any importance at this point was from trains on the Southern Railway, which passed about half a mile south of the station.

The galvanometer was suspended from the north side of a post, about 10 inches in diameter, set 3 feet in the ground. The surrounding forests and mountains broke the force of the wind somewhat, but the oscillations produced in the galvanometer by even a moderately brisk wind were very annoying.

At Asheville the instruments were generally read and data recorded in the following order:

1. Galvanometer scale, with bands *A* and *B* of the pyrheliometer both exposed to the sun.
2. Attached thermometer of pyrheliometer.
3. Watch time.
4. Ammeter, with band *A* of pyrheliometer exposed (the left band, as seen when looking from the rear) and current passing through *B*.
5. Ammeter, with band *B* exposed (the one on the right, as seen from the rear) and current passing through *A*.
6. Same as 5.
7. Same as 4.
8. Watch time.
9. Attached thermometer of pyrheliometer.
10. Sling psychrometer.
11. Character of wind and kind and amount of clouds.
12. Galvanometer scale, with bands *A* and *B* of the pyrheliometer both exposed to the sun.
13. Polarimeter, the tube being first sighted on the sun and the azimuth and altitude read off. The tube was then revolved about its horizontal axis to a point in the sky 90° from the sun and on the same vertical circle with it, where four readings, or two determinations, of the polarization of the sky light were made while revolving the Nicol prism in a clockwise direction and the same number while revolving it in the opposite direction.
14. The blueness of the sky 90° from the sun and the clearness with which distant mountains could be seen were each recorded on the scale 0–10.

being 0.028 ampere. The principal exceptions to the rule were when the sun was just above the horizon. In this position its radiation was subject to absorption and reflection from so many sources that irregularities in the readings were to be expected.

This apparent difference in bands *A* and *B* has been the subject of much speculation. As has already been indicated, each observation requires that the heating effect of the sun on one of the bands be balanced against the heating effect of an electric current on the other band four times in succession, the bands being exposed to the sun in the following order:

(1) *A* exposed; (2) *B* exposed; (3) *B* exposed; (4) *A* exposed. The mean current required to balance the heating effect of the sun for each of these exposures—(1), (2), (3), and (4)—has been computed for the four following series:

November series: 50 observations at Asheville between November 10 and 15. January series: 50 observations at Asheville between January 12 and February 13. Black Mountain series: 43 observations at Black Mountain between February 19 and March 25. Washington series: 12 observations at Washington, D. C., in April, 1903. The results are given in Table 2.

The departure from mean of Table 2 may be compared with columns 6, 7, 8, and 9, of Davis's Table 2,[3] remembering that his readings were made in the reverse order from mine; that is, the order of exposure of the bands in his case was *B*, *A*, *A*, *B*, while in mine it was *A*, *B*, *B*, *A*.

The rhythm in the readings has the same order of sequence in both cases, though less marked in mine than his, and is undoubtedly due to lag in the heating and cooling of the bands. This lag was especially noticeable with band *A* exposed. If sufficient current was switched on to quickly heat *B* to the

TABLE 1.—*Original record of pyrheliometer and polarimeter observations at Asheville, N. C., February 4, 1903.*

Time.	Radiation—Pyrheliometer.						Polarization.										
	Attached therm'r.	Band exposed.			Mean of *A* and *B*.	*Q*.	Time.	Sun's—			Polarimeter readings.						
		A and *B*.	*A*.	*B*.				Azimuth.	Altitude.	Altitude +90°.	1.	2.	3.	4.	2-1.	4-3.	4 *V*.	*P*.
	°*C*.	*Gal*.	*Amm*.	*Amm*.	°			°	°	°								
9:30 a. m.	16.0	119.5	142	137	137	0.159	9:43 a. m.	310.4	22.2	112.2	96.1	174.5	278.1	355.3	78.4	77.2	155.6	21.1
9:37 a. m.	17.9	120.7	271	254	262	0.563	9:48 a. m.	310.4	.....	112.2	95.2	179.2	274.0	352.5	84.0	78.5	162.5	15.2
10:30 a. m.	17.1	123.0	106	99	102	0.090	10:50 a. m.	325.5	31.0	121.0	97.9	173.0	278.2	353.0	75.1	74.8	149.9	26.0
10:44 a. m.	16.1	123.0	69	36	52	0.026	10:55 a. m.	325.2	.....	117.0	99.5	171.5	279.8	351.2	72.0	71.4	143.4	31.4
11:48 a. m.	15.0	123.2	36	22	29	0.009	12:06 p. m.	346.9	37.0	127.0	104.1	167.0	282.2	346.1	62.9	63.9	126.8	44.8
11:58 a. m.	16.2	123.0	143	25	84	0.062	12:11 p. m.	347.0	.....	126.5	104.2	166.2	284.8	347.0	62.0	62.2	124.2	46.8
12:31 p. m.	18.5	122.5	351	369	360	1.041	12:49 p. m.	359.3	37.5	127.5	104.0	166.1	285.2	346.1	62.1	60.9	123.0	47.7
12:43 p. m.	18.0	123.0	342	368	355	1.012	12:53 p. m.	359.3	.....	127.2	103.6	166.1	284.6	346.1	62.5	61.5	124.0	47.0
1:30 p. m.	17.9	124.0	335	361	348	0.971	1:48 p. m.	16.9	35.2	125.2	103.5	166.1	284.7	346.7	62.6	62.0	124.6	46.5
1:42 p. m.	17.8	124.1	335	360	348	0.971	1:54 p. m.	16.9	.....	124.7	104.1	166.2	284.1	346.4	62.1	62.3	124.4	46.7
2:57 p. m.	18.0	124.5	322	350	336	0.912	3:12 p. m.	38.7	27.1	117.1	103.5	165.8	284.3	346.3	62.3	62.0	124.3	46.8
3:06 p. m.	17.1	124.5	311	343	327	0.865	3:18 p. m.	38.7	.....	116.8	103.9	165.9	284.2	346.1	62.0	61.9	123.9	47.1
4:00 p. m.	16.1	122.0	287	305	296	0.715	4:18 p. m.	52.3	17.0	107.0	103.2	167.1	283.9	346.8	63.9	62.9	126.8	44.8
4:12 p. m.	15.6	122.0	273	305	289	0.682	4:23 p. m.	52.3	.....	107.0	103.7	166.8	284.1	346.9	63.1	62.8	125.9	45.5
4:57 p. m.	13.3	116.0	221	255	238	0.465	5:11 p. m.	61.5	8.0	97.0	101.5	168.0	282.2	348.2	66.5	66.0	132.5	40.3
5:05 p. m.	13.3	117.7	217	255	236	0.454	5:16 p. m.	61.1	.....	97.0	101.7	168.1	281.9	348.3	66.4	66.4	132.8	40.1
5:40 p. m.	10.9	132.0	129	121	125	0.133	*5:52 p. m.	67.5	0.0	90.2	100.3	169.4	282.0	348.9	69.1	66.9	136.0	37.5
5:49 p. m.	10.6	132.0	86	104	95	0.079	*6:02 p. m.	68.9	.....	88.5	107.5	162.9	289.0	342.0	55.4	53.0	108.4	58.5
							*6:12 p. m.	70.3	.....	86.8	106.5	165.0	285.0	345.9	58.5	60.9	119.4	50.5
							*6:19 p. m.	71.7	.....	85.1	105.0	165.1	286.1	344.6	60.1	58.5	118.6	51.1

NOTE.—Watch 15 seconds fast. *After sunset; sky pink and yellow to zenith and very brilliant.

At Black Mountain the sling psychrometer (item 10) was read last.

Table 1 shows all the details of the observations with the pyrheliometer and the polarimeter as actually recorded on February 4, 1902. The morning observations on this day were made through clouds, and the marked fluctuations in the solar radiation and the polarization of sky light will be noted. The afternoon observations were made under favorable conditions, except that the wind was high. The readings of the polarimeter were fairly regular until after sunset, when darkness made accurate observing difficult.

It will be noted that with band *A* of the pyrheliometer exposed, less current was required to bring about thermoelectric equilibrium, as indicated by the galvanometer, than with band *B* exposed, the average difference from 12:31 p. m. to 5:05 p. m. temperature of *A*, *B* became overheated, and it was necessary to diminish the current. A succession of increases and decreases in the current would follow, until thermoelectric equilibrium was established. The lag was noticeable to a less degree with band *B* exposed.

The mean current with *A* exposed averaged 0.0276 ampere less than with *B* exposed in my work, as compared with 0.0226 ampere less in the work of Davis. The difference 0.005 is only one scale division on the ammeter and is not larger than we would expect, since the difference in the order of exposure brought the effect of lag upon different strips. The mean of (1) and (2) in my case is 0.0016 ampere greater than the mean of (3) and (4), while Davis found the mean of (3) and (4) to be 0.0023 the greater.

[3] See Monthly Weather Review for June, 1902, p. 277.

TABLE 2.—*Mean current with different pyrheliometer exposures.*

Series.	Exposure. (1)	(2)	(3)	(4)	Mean.
Asheville:					
November	.306	.331	.328	.306	.318
January	.273	.302	.299	.269	.285
Black Mountain:					
February and March	.269	.306	.300	.275	.288
Washington:					
April	.311	.342	.338	.317	.327
Weighted means	.2855	.3157	.3115	.2864	.2998

Series.	Departure from mean. (1)	(2)	(3)	(4)	$\frac{(2)+(3)}{2}-\frac{(1)+(4)}{2}$
Asheville:					
November	−.012	+.013	+.010	−.012	+.0235
January	−.012	+.017	+.014	−.016	+.0295
Black Mountain:					
February and March	−.019	+.018	+.012	−.013	+.0310
Washington:					
April	−.016	+.015	+.011	−.010	+.0260
Weighted means	−.0143	+.0159	+.0117	−.0134	+.0276

The shifting of the zero point of the galvanometer scale (i. e., the reading with zero current when *A* and *B* are both exposed) is referred to by Davis and is shown in column 3 of Table 1. This appears to be purely a temperature effect. While installing the apparatus at Asheville on November 8, with the sun shining directly upon the galvanometer, it was found that when cumulus clouds were passing over the sun the zero of the scale shifted so rapidly that it was impossible to make observations. A wooden box was therefore arranged so as to shade the galvanometer, and with excellent results. The slow movements shown in Table 1 are quite unimportant. The marked difference between 5:05 p. m. and 5:40 p. m. is due to a readjustment of the instrument.

After each reading of the ammeter the current was immediately cut off. At the completion of each series of four readings band *A* was thus left exposed to the sun for some seconds, while band *B* was shaded and without any current passing through it. The shutter was then generally arranged so as to expose both *A* and *B*, to redetermine the zero of the galvanometer; but so much time was required for *B* to acquire the temperature of *A* that frequently I detached one of the galvanometer wires, or opened the circuit, so as to obtain the zero of the scale at once. A great many readings showed no appreciable difference between the zero determined by *opening the circuit* and that determined by a long exposure of both bands to the sun.

TABLE 3.—*Corrections to Weston ammeter No. 4315.*

Scale reading.	By Bureau of Standards.	By ammeter No. 4321.	By H. M. Davis. Nov., 1901.	April, 1902.
0	+5.5	+6.5	+8.0	+8.0
50	5.0	5.0	8.0	7.2
100	5.5	6.0	8.0	8.0
150	4.5	4.5	7.0	6.4
200	5.0	5.0	7.0	7.0
250	4.5	4.8	6.0	7.4
300	4.5	5.3	6.0	6.8
350	3.0	5.0	5.0	4.8
400	2.0	3.8	4.0	3.8
450	+1.0	2.7	+2.0	+2.7
500	−0.5	+1.0	±0.0	±0.0

Upon returning to Washington, steps were at once taken to determine, if possible, the corrections to Weston ammeter No. 4315 and pyrheliometer No. 28. The ammeter was first compared with a similar instrument, No. 4321, which had recently been calibrated by the Bureau of Standards, and was then taken to that bureau for a direct determination of its errors. In the method adopted by this bureau the current corresponding to a given scale reading was determined by measuring the fall in potential of the current in passing through a known resistance. Table 3 shows the results of these tests, as also those obtained by Davis, who compared this ammeter with a Thomson current balance belonging to the laboratory of Brown University.

The corrections determined directly by the Bureau of Standards have been applied to all my readings at Asheville and Black Mountain.

On April 9 pyrheliometer No. 28 was compared with pyrheliometer No. 34, the latter having been kept in the Instrument Division of the Weather Bureau ever since it was purchased, in 1901. The temporary support provided for the galvanometers was quite unstable, and clouds commenced to form soon after observations were begun, so that only two complete sets of readings were obtained. These are given in Table 4.

TABLE 4.—*Comparison of pyrheliometers, April 9, 1903.*

Time.	No. 28. Temperature.	Band exposed. *A* and *B*.	*A*.	*B*.	*Q*.	No. 34. Temperature.	Band exposed. *A* and *B*.	*A*.	*B*.	*Q'*.
	°C.	*Gal.*	*Amp.*	*Amp.*	*Cal.*	°C.	*Gal.*	*Amp.*	*Amp.*	*Cal.*
2:10 p. m.	24.7	112.0	0.312	0.317	0.801	23.6	134.0	0.340	0.355	0.876
2:15 p. m.	24.8	112.0	0.310	0.323	0.811	24.0	134.0	0.345	0.355	0.887
2:27 p. m.	24.2	111.0	0.317	0.305	0.786	23.8	137.0	0.345	0.325	0.812
2:42 p. m.	25.0	112.0	0.300	0.303	0.741	24.8	137.0	0.335	0.321	0.779
Means					0.7848					0.8385

The mean value of the solar radiation as measured by No. 28 was only 93.6 per cent of the radiation as measured by No. 34. This result may be compared with the comparative readings of these same instruments obtained by Professor Marvin[4] in October, 1901, when the mean of ten observations with No. 34 gave for the radiation 0.8096, while simultaneous observations with No. 28 gave 0.7424, or only 91.7 per cent of the result by No. 34.

Furthermore, Professor Marvin's readings show for exposures (1), (2), (3), and (4) of each observation, the values given in Table 5, the bands having been exposed in the same order as by me, i. e., *A*, *B*, *B*, *A*.

TABLE 5.

	Exposures. (1)	(2)	(3)	(4)	Mean.	$\frac{(2+3)}{2}-\frac{(1+4)}{2}$
Amperes	0.2920	0.3237	0.3187	0.2873	0.3055	+0.0316
Residuals	−0.0135	+0.0182	+0.0132	−0.0182		

Comparing Table 5 with Table 2 and with Davis's Table 2, we find no evidence of any change having occurred in pyrheliometer No. 28 since October, 1901; and if we assume that the observations of October 29, 1901, and April 9, 1903, are equally good, it follows that No. 28 gives results that are 92.0 per cent of those given by No. 34.

A very critical examination of the bands *A* and *B* of No. 28 showed that the platinum foil of *B* had buckled so as to separate it slightly from the copper foil back of it, just over the thermoelectric junction. This will explain why, with *A* exposed, a long time was required for the electric current to bring the temperature at the thermoelectric junction on *B* up to the temperature of the junction on *A*. It will also explain why, after exposure (4), with the sun left shining on *A*, when the shutter was adjusted to expose both bands considerable

[4] See Monthly Weather Review, October, 1901, Vol. XXIX, pp. 457–458.

time was required to bring about thermoelectric equilbrium at the back of the bands. It does not explain why with band *A* exposed less current was required to balance the heating effect of the sun than with band *B* exposed. In fact, we should expect the opposite effect.

An attempt was made by the Instrument Division to measure the resistance of bands *A* and *B*, but, unfortunately, the surface of *B* was scratched slightly and some of the platinum block removed.

The comparative readings of Nos. 28 and 34 made after this accident occurred are shown in Table 6 and are of interest. posures (1), (2), (3), and (4) on April 29, 30, and May 1 we obtain the following:

	Exposures					$\frac{2+3}{2}-\frac{1+4}{2}$
	(1)	(2)	(3)	(4)	Mean.	
Amperes	0.323	0.357	0.359	0.325	0.341	+0.034
Residuals	−0.018	+0.016	+0.018	−0.016	.....	.....

I can not account for the residuals remaining so nearly as before, while the deflection of the galvanometer with both

TABLE 6.—*Comparison of pyrheliometers Nos. 28 and 34.*

Time.	No. 28.				Time.	No. 34.				
	Temperature.	Band exposed to sun.		Q'.		Temperature.	Band exposed to sun.			Q'.
		A and *B*.	*A*.	*B*.			*A* and *B*.	*A*.	*B*.	
April 28.	°C.	*Galvanometer.*	*Ammeter.*	*Ammeter.*	*Calories.*	April 28.	°C.	*Galvanometer.*	*Ammeter.*	*Ammeter.*	*Calories.*
9:54 a. m.	23.9	110.9	353	339	0.965	10:08 a. m.	24.8	123.5	387	392	1.101
10:06 a. m.	23.0	114.0	351	337	0.952	10:18 a. m.	24.0	122.0	393	392	1.113
10:38 a. m.	23.8	116.0	361	347	1.009	10:22 a. m.	24.8	121.9	391	387	1.095
10:46 a. m.	25.9	114.0	375	337	1.021	10:35 a. m.	25.5	121.5	388	379	1.068
10:59 a. m.	24.8	116.0	362	329	0.965	10:47 a. m.	25.4	120.4	379	402	1.101
11:09 a. m.	26.5	116.0	357	338	0.977	10:57 a. m.	26.0	121.0	393	402	1.147
11:14 a. m.	25.2	117.0	363	350	1.021	11:25 a. m.	26.5	118.0	402	401	1.172
11:23 a. m.	26.5	114.0	372	344	1.033	11:34 a. m.	26.5	117.9	398	405	1.172
11:48 a. m.	25.9	116.5	369	341	1.015	11:36 a. m.	26.9	118.3	384	398	1.109
11:56 a. m.	26.9	115.5	373	346	1.045	11:46 a. m.	27.8	119.9	395	403	1.154
12:01 p. m.	27.4	115.0	364	342	1.005	12:13 p. m.	26.0	115.5	392	401	1.137
12:09 p. m.	27.8	114.5	372	332	0.999	12:23 p. m.	28.6	120.0	384	398	1.109
12:37 p. m.	27.9	116.8	368	343	1.022	12:26 p. m.	28.7	120.0	386	395	1.103
12:48 p. m.	28.0	116.5	372	337	1.010	12:35 p. m.	28.7	120.5	394	393	1.125
1:25 p. m.	28.0	117.9	363	348	1.022	1:39 p. m.	29.0	119.0	379	393	1.081
1:35 p. m.	30.5	118.5	369	332	0.989	1:50 p. m.	30.0	120.2	366	381	1.015
2:04 p. m.	30.9	121.0	361	338	0.989	1:54 p. m.	29.9	121.0	387	392	1.104
2:14 p. m.	30.7	124.5	362	337	0.989	2:02 p. m.	30.0	121.5	388	394	1.110
2:27 p. m.	30.0	126.0	356	337	0.967	2:16 p. m.	29.8	121.7	389	396	1.117
2:34 p. m.	31.1	126.0	364	325	0.956	2:24 p. m.	29.3	120.2	391	398	1.127
Means	.....	.....	.....	.....	0.998	.....	.....	.....	.....	.....	1.113

Time.	No. 28.					Time.	No. 34.				
	Temperature.	Circuit open.	Band exposed.		Q'.		Temperature.	Band exposed to sun.			Q'.
			A.	*B*.				*A* and *B*.	*A*.	*B*.	
April 29.											
11:08 a. m.	28.2	125.5	310	348	0.879	11:17 a. m.	29.9	127.2	364	369	0.973
11:15 a. m.	28.5	125.5	312	349	0.885	11:30 a. m.	30.8	128.0	364	368	0.973
11:48 a. m.	30.0	126.5	310	326	0.823	11:36 a. m.	30.8	129.0	363	366	0.962
11:56 a. m.	29.7	127.0	316	337	0.864	11:44 a. m.	31.2	128.7	366	364	0.967
11:57 a. m.	29.8	127.0	311	342	0.864	12:08 p. m.	30.9	130.0	367	372	0.994
12:06 p. m.	29.7	127.0	319	329	0.854	12:14 p. m.	30.9	130.0	366	371	0.983
April 30.											
11:49 a. m.	35.3	109.0	319	362	0.936	11:59 a. m.	34.9	133.0	377	383	1.050
11:57 a. m.	35.1	109.0	321	361	0.942	12:07 p. m.	34.0	133.0	379	382	1.050
12:22 p. m.	33.1	111.0	326	356	0.941	12:11 p. m.	35.0	134.0	380	379	1.050
12:31 p. m.	33.9	111.0	325	364	0.957	12:18 p. m.	34.0	131.0	381	378	1.050
May 1.											
10:25 a. m.	12.4	124.5	344	385	1.061	10:36 a. m.	13.0	126.5	401	406	1.175
10:32 a. m.	12.0	124.5	343	391	1.079	10:43 a. m.	13.0	126.5	410	400	1.181
10:57 a. m.	12.5	124.0	341	382	1.050	10:45 a. m.	13.1	126.5	402	410	1.188
11:07 a. m.	12.1	124.0	339	380	1.021	10:53 a. m.	12.9	129.0	400	410	1.175
Means	.....	.....	.....	.....	0.940	.....	.....	.....	.....	.....	1.055

On April 28, 1903, the zero of the scale was determined with both bands exposed to the sun. The change in the sign of the difference between the ammeter readings with the current through bands *A* and *B*, respectively, was noted, and investigation showed that the zero of the scale thus determined was about 25 scale divisions in error; in other words, with both bands exposed to the sun there was a current through the galvanometer, due to the fact that *A* acquired a higher temperature than *B*. On April 29, 30, and May 1 the zero of the scale was determined with the circuit open. Very little error in Q' resulted from this erroneous determination of the zero of the scale on April 28, however, since the mean radiation, as measured by No. 28 on that date, was 89.6 per cent of the radiation as measured by No. 34, while on April 29, 30, and May 1 it was 89.1 per cent.

Computing, for No. 28, the mean current employed with exbands exposed shows that *A* absorbed so much more heat than *B*, unless the resistance of *B* was increased when its surface was scratched, as may have been the case when we consider its extreme thinness. This would also seem to indicate that the reason why band *B* has all along required less current to heat it than band *A* is that a slight fracture at the point where it buckled increased its resistance. A second accident to band *B*, while an attempt was being made by the Instrument Division to blacken the scratched surface, damaged it so seriously as to prevent further investigation of its errors.

Early in June, 1903, a new set of bands, equivalent to a new pyrheliometer, and called by Ångström No. 41, was received by the Weather Bureau apparently in excellent condition, and the comparative readings in Table 7 were made.

The means of the 6 sets of readings by the two instru-

ments differ from each other by less than 1 per cent. On October 25, 1902, Professor Marvin[5] compared pyrheliometer No. 34 with No. 31, the mean of the results by No. 31 being 1.106 calories, and by No. 34, 1.100 calories, also a difference of less than 1 per cent. The Ångström pyrheliometers Nos. 31, 34, and 41 are therefore in practical agreement, while the indications of No. 28 are only 92 per cent of the indications by the other three, and it is fair to assume that this difference has been constant ever since the instrument was received in October, 1901. The values of the radiation indicated by No. 28 have therefore been divided by 0.92 to obtain the Q of Tables 8 and 9. This Q is believed to be comparable with the results obtained by Ångström with his similar and standard instrument in Europe.

TABLE 7.—*Comparison of pyrheliometers Nos. 41 and 34.*

Time.	Pyrheliometer No. 41.					Time.	Pyrheliometer No. 34.				
	Temperature.	Band exposed to sun.			Q'.		Temperature.	Band exposed to sun.			Q'.
		A and *B*.	*A*.	*B*.				*A* and *B*.	*A*.	*B*.	
June 16.	°C.	*Galvanometer.*	*Ammeter.*	*Ammeter.*	*Calories.*	June 16.	°C.	*Galvanometer.*	*Ammeter.*	*Ammeter.*	*Calories.*
10:54 a. m.	28.8	117.5	388	384	1.053	11:03 a. m.	29.5	131.0	375	384	1.059
11:00 a. m.	28.2	120.0	388	384	1.052	11:09 a. m.	30.0	128.5	374	383	1.048
11:18 a. m.	28.5	120.0	389	386	1.064	11:11 a. m.	30.5	128.5	374	382	1.048
11:24 a. m.	29.0	121.0	385	385	1.048	11:16 a. m.	30.5	128.5	377	380	1.048
June 18.						June 18.					
9:43 a. m.	22.8	109.5	381	384	1.029	9:55 a. m.	24.8	126.8	376	370	1.025
9:51 a. m.	22.9	109.5	385	389	1.056	10:04 a. m.	26.0	126.5	375	375	1.036
10:20 a. m.	24.8	110.0	382	382	1.029	10:07 a. m.	26.2	126.6	378	375	1.036
10:40 a. m.	23.9	114.0	386	381	1.040	10:18 a. m.	26.9	126.5	374	378	1.036
1:28 p. m.	27.1	119.0	391	391	1.079	1:41 p. m.	29.5	126.0	377	376	1.037
1:36 p. m.	28.0	121.0	390	393	1.085	1:51 p. m.	29.5	126.0	374	373	1.032
2:06 p. m.	28.0	121.5	377	379	1.009	1:55 p. m.	30.1	126.1	370	374	1.021
2:17 p. m.	28.2	122.5	375	374	0.988	2:04 p. m.	29.5	125.9	369	373	1.016
Means	.....	.....	.....	.....	1.044	.....	.....	.....	.....	.....	1.037

In Tables 8 and 9 are given the observations obtained at Asheville and Black Mountain, N. C., respectively. An effort was made to obtain nine complete observations each day at about hourly intervals, but until the new rheostat constructed by Professor Marvin was received on January 29, 1903, it was only possible to measure the radiation when the sunlight was sufficiently strong to cast a distinct shadow. After that date the radiation could be measured whenever the clouds were sufficiently thin to permit the sun's position to be determined.

At Asheville 84 observations on thirteen days were obtained in November; 83, on thirteen days in December; 129, on twenty days in January, and 52 observations on nine days during the first half of February. At Black Mountain 134 observations on twenty-one days were obtained between February 19 and March 26, inclusive.

The pyrheliometer was not in working order from December 1 to December 6, inclusive, so that, omitting Sundays and holidays, at Asheville 52 per cent of the possible nine observations per day were obtained during November; 46 per cent during December and 55 per cent during January, during which months observations were taken only when the sun was shining brightly enough to cast a distinct shadow. At Asheville, during the first half of February, 48 per cent, and at Black Mountain, between February 19 and March 26, 50 per cent of the possible observations were obtained, and they were taken whenever the position of the sun could be seen.

In Tables 8 and 9, column 1 gives the date and the seventy-fifth meridian time of the observations, the time being the mean of the time of beginning of exposure (1) and the ending of exposure (4) of the pyrheliometer bands. The hour angle in column 2 is obtained from column 1 by applying the equation of time and a correction for the number of degrees of longitude that the stations are west of the seventy-fifth meridian. The sun's altitude, in column 3, was computed for the Asheville observations, but for the Black Mountain observations it was obtained from the vertical circle readings of the polarimeter, which were checked each day at apparent noon by computation from the formula h = colatitude + sun's declination. A correction was also applied for the difference in time between the pyrheliometer and the polarimeter observations.

The number of atmospheres through which the solar rays had to pass, s, of column 4, was obtained by interpolation in the tabulated values of Bouguer's formula given on page 22 of R. Radau's Actinométrie, Paris, 1877, the interpolation being facilitated by a table of cosecants of h for each degree; the interpolated values thus obtained were multiplied by the ratio of the actual barometric pressure, B, to the normal atmospheric pressure at sea level, 29.92 inches.

In column 5 Q' is the number of calories of heat received each minute upon a square centimeter of surface normal to the sun's rays, as measured by pyrheliometer No. 28. Dividing Q' by 0.92 to correct for the instrumental error of No. 28, we obtain Q in column 6.

The sling psychrometer, from which the air temperature t, of column 7, the relative humidity *R. H.*, of column 8, and the vapor pressure e, of column 9, were obtained, was whirled in the shade of a tree, and at Black Mountain, on the bank of a small stream. The barometric pressure B, of column 10, was read off from the Asheville barograph sheets, a correction being applied for the difference in level between the barograph and the pyrheliometer. Wind direction and velocity, recorded in columns 11 and 12, were taken from the Asheville record sheets. Under P, in column 13, is recorded the percentage of polarization of the sky light, as determined by the polarimeter observations, which were taken about ten minutes later than the pyrheliometer observation at Asheville, and about five minutes later at Black Mountain.

Under "Sky," in column 14, is recorded on scale 0–10, the blueness of the sky where the polarization was observed. Under "Mt." in column 15, is recorded on scale 0–10, the clearness with which distant mountains could be seen. At Asheville the mountains usually observed for this data were Pisgal and Cold Mountain, distant 17 and 20 miles southwest of the city, respectively, and their direction from the observing point explains why they were so much clearer in the morning than in the afternoon. At Black Mountain, peaks in several directions were observed, the most distant being Craggy Dome, seven miles to the northwest.

Under "Character of the sky," it must be understood that when "Light haze," "Dense Smoke," etc., is recorded "At sun," the same condition also applies to other parts of the sky. The

[5] See Monthly Weather Review for October, 1901, Vol. XXIX, pp. 457, 458.

TABLE 8.—*Pyrheliometer observations at Asheville, N. C. Latitude 35° 36′ north; longitude 82° 32′ west. Elevation above sea level, 2200 feet.*

Date and time (75th meridian time).	Hour angle.	*h.*	*c.*	*Q′.*	*Q.*	*t.*	*R.H.*	*e.*	*B.*	Wind.		*P.*	Sky.	Mt.	Character of sky.	
										Dir.	Vel.				At sun.	In general.
November 10.	°	°				°F.	%	*Inch.*	*Inches.*		*M. p. h.*	%				
10:06 a. m..	32.00	29.3	1.90	0.958	1.041	54	65	0.266	27.97	nw.	6	.....	7	.....	Light haze....	No clouds.
10:36 a. m .	24.50	32.5	1.75	0.983	1·068	58	62	0.298	27.97	nw.	7	.....	7	.....	....do	Few cirrus in southwest.
11:07 a. m..	16.75	35.1	1.62	1.022	1.111	61	56	0.298	27.96	nw.	8	.....	7	.....	....do	Do.
11:38 a. m..	9.00	36.7	1.56	1.010	1.098	64	45	0.266	27.95	nw.	12	.....	7	.....	....do	Do.
12:11 p. m..	0.75	37.4	1.53	0.996	1.083	66	39	0.256	27.93	nw.	7	.....	7	.....	....do	Do.
12:41 p. m..	6.75	37.0	1.55	1.034	1.124	68	42	0.287	27.91	nw.	7	.....	7	.....	....do	Do.
1:06 p. m..	13.00	35.9	1.58	1.039	1.129	68	37	0.277	27.90	nw.	10	.....	8	.....	....do	Do.
1:39 p. m..	21.25	33.5	1.69	0.936	1.017	68	37	0.261	27.89	nw.	12	.....	8	.....	....do	Do.
3:05 p. m..	42.75	23.6	2.31	0.867	0.942	69	34	0.247	27.88	nw.	8	.....	8	.....	....do	Do.
4:06 p. m..	58.00	14.0	3.77	0.658	0.715	67	43	0.287	27.89	nw.	8	.....	8	.....	....do	Do.
November 11.																
9:38 a. m..	39.00	25.4	2.16	0.406	0.441	53	82	0.334	28.04	sw.	2	.....	6	.....	Dense haze ...	3 alto-cumulus.
10:32 a. m..	25.50	31.7	1.78	0.620	0.674	59	68	0.347	28.04	sw.	1	.....	6	.....	....do	Few alto-cumulus.
11:03 a. m..	17.75	34.4	1.65	0.868	0.943	64	59	0.347	28.03	sw.	3	.....	6	.....	Light haze....	Few alto-cumulus in southwest.
11:32 a. m..	10.50	36.1	1.58	1.116	1.213	67	55	0.360	28.02	sw.	3	.....	7	.....	....do	Few alto-cumulus in southwest; few cumulus in east.
12:37 p. m..	5.75	36.7	1.56	1.072	1.165	72	42	0.316	28.00	s.	10	.....	7	.....	....do	Few cumulus on horizon.
1:35 p. m..	20.25	33.7	1.68	0.976	1.061	72	44	0.347	27.97	se.	12	.....	8	.....	....do	Few cumulus.
3:06 p. m..	43.00	23.1	2.36	0.878	0.954	71	43	0.322	27.95	se.	12	.....	8	.....	Clear	Few fracto-cumulus.
4:06 p. m..	58.00	13.8	3.84	0.698	0.759	70	40	0.287	27.95	se.	12	.....	8	.....	....do	Few cumulus in east.
4:35 p. m..	65.25	8.5	6.00	0.476	0.517	68	43	0.298	27.95	s.	10	.....	8	.....	....do	Few cirrus; few cumulus.
November 12.																
9:20 a. m..	43.50	22.8	2.40	0.822	0.893	50	73	0.256	28.03	s.	2	.....	7	.....	Light haze....	Dense haze near station.
9:37 a. m..	39.25	25.1	2.19	0.818	0.889	53	66	0.277	28.03	s.	3	.....	7	.....	....do	Do.
10:13 a. m..	30.25	29.6	1.88	0·942	1.024	58	62	0.287	28.03	s.	3	.....	7	.....	....do	Do.
10:33 a. m..	25.25	31.6	1.78	0.993	1.079	62	52	0.287	28.03	s.	4	.....	8	.....	....do	No clouds.
11:07 a. m..	16.75	34.4	1.65	1.042	1.133	66	42	0.266	28.02	s.	8	.....	8	.....	....do	Few cirrus in east.
11:34 a. m..	10.00	35.9	1.59	1.108	1.204	66	42	0.266	28.01	s.	7	.....	8	.....	....do	No clouds.
12:35 p. m..	5.25	36.5	1.57	1.088	1.183	70	33	0.247	27.99	s.	6	.....	8	.....	....do	Do.
1:40 p. m..	21.50	33.0	1.71	1.004	1.091	72	32	0.247	27.95	se.	6	.....	8	.....	....do	Do.
3:06 p. m..	43.00	23.1	2.36	0.951	1.034	71	31	0.237	27.92	se.	8	.....	8	.....	....do	Do.
4:04 p. m..	57.50	14.0	3.78	0.726	0.789	68	38	0.261	27.92	s.	12	.....	7	.....	....do	Few cirrus in northwest.
4:33 p. m..	64.75	8.7	5.86	0.512	0.557	67	39	0.256	27.92	s.	12	.....	7	.....	....do	Do.
November 13.																
9:03 a. m..	47.75	20.0	2.72	0.526	0.572	44	84	0.247	28.06	sw.	2	.....	6	.....	Dense smoke..	No clouds.
9:31 a. m..	40.75	24.0	2.29	0.532	0.578	49	76	0.247	28.06	sw.	2	.....	6	.....	....do	Do.
10:34 a. m..	25.00	31.5	1.79	0.726	0.789	57	62	0.287	28.06	sw.	2	.....	7	.....	....do	Do.
11:32 a. m..	10.50	35.6	1.60	0.820	0.891	64	53	0.310	28.04	sw.	3	.....	7	.....	....do	Few cumulo-stratus in south.
12:35 p. m..	5.25	36.3	1.58	0.852	0.926	67	49	0.322	28.03	se.	3	.....	7	.....	Light haze....	Do.
1:34 p. m..	20.00	33.2	1.70	1.036	1.126	70	45	0.322	27.99	s.	4	.....	8	.....	....do	Do.
3:03 p. m..	42.25	23.0	2.37	0.918	0.998	70	47	0.347	27.95	s.	10	.....	8	.....	....do	Do.
4:05 p. m..	57.75	13.5	3.90	0.618	0.672	69	52	0.373	27.94	se.	12	.....	8	.....	....do	Few cumulo-stratus in southwest.
4:36 p. m..	65.50	8.0	6.30	0.397	0.432	.....	.....	.....	27.94	se.	10	.....	8	.....	....do	Few cumulo-stratus in east.
November 14.																
10:47 a. m..	21.75	32.5	1.73	0.764	0.830	65	73	0.448	27.99	ne.	3	.....	6	.....	....do	1 cumulo-stratus.
12:12 p. m..	0.75	36.3	1.58	0.986	1.072	69	68	0.482	27.97	se.	10	.....	8	.....	....do	3 cumulo-stratus.
12:31 p. m..	4.25	36.1	1.58	1.014	1.102	68	62	0.417	27.94	se.	10	.....	8	.....	....do	Do.
1:47 p. m..	23.25	32.0	1.75	0.942	1.024	68	54	0.373	27.91	se.	13	.....	8	.....	Clear	4 cumulo-stratus.
3:06 p. m..	43.00	22.5	2.42	0.790	0.859	70	53	0.387	27.89	se.	15	.....	8	.....	....do	3 cumulus.
4:04 p. m..	57.50	13.5	3.91	0.527	0.573	66	62	0.402	27.89	se.	15	.....	8	.....	Partly cloudy.	4 cumulo-stratus.
4:35 p. m..	65.25	8.1	6.22	0.343	0.373	65	62	0.402	27.89	se.	15	.....	8	.....	....do	1 cumulo-stratus.
November 15.																
9:13 a. m..	45.50	20.9	2.59	0.438	0.476	49	93	0.322	27.90	calm.	0	.....	6	.....	Dense smoke..	Dense fog, dissipating.
9:35 a. m..	40.00	24.1	2.26	0.626	0.680	52	88	0.334	27.90	calm.	0	.....	6	.....	....do	No clouds.
10:35 a. m..	25.00	31.0	1.80	0.682	0.741	60	76	0.402	27.90	s.	2	.....	6	.....	....do	Do.
11:36 a. m..	9.75	35.3	1.61	0.867	0.942	65	59	0.373	27.90	sw.	3	.....	6	.....	Light haze....	Few cumulo-stratus in south.
12:37 p. m..	5.50	35.7	1.59	0.894	0.972	69	50	0.360	27.88	n.	6	.....	7	.....	....do	Few cumulus in south and west.
1:38 p. m..	20.75	32.5	1.72	0.992	1.078	71	50	0.373	27.84	nw.	8	.....	8	.....	....do	Do.
3:05 p. m..	42.75	22.5	2.42	0.870	0.946	72	50	0.402	27.82	nw.	8	.....	8	.....	....do	Few cumulus on horizon.
4:06 p. m..	57.75	13.2	3.98	0.660	0.717	72	53	0.402	27.81	nw.	3	.....	8	.....	....do	Do.
4:35 p. m..	64.75	8.3	6.08	0.421	0.458	70	52	0.387	27.81	nw.	4	.....	7	.....	....do	Do.
November 18.																
11:18 a. m..	14.25	33.6	1.67	0.720	0.783	57	81	0.373	27.76	nw.	14	.....	8	.....	Partly cloudy.	6 cumulo-stratus.
11:39 a. m..	9.00	34.6	1.63	0.940	1.022	59	78	0.378	27.76	nw.	15	.....	8	.....	Clear	4 cumulo-stratus.
12:38 p. m..	5.75	34.9	1.61	0.945	1.027	58	78	0.373	27.76	nw.	15	.....	8	.....	....do	Do.
1:35 p. m..	20.00	32.0	1.74	0.990	1.076	58	76	0.360	27.75	n.	15	.....	8	.....	....do	Few cumulus; few cumulo-stratus.
3:08 p. m..	43.25	21.6	2.51	0.824	0.896	59	71	0.360	27.75	nw.	10	.....	8	.....	....do	Few cumulo-stratus on horizon.
4:07 p. m..	58.00	12.6	4.16	0.668	0.726	57	74	0.347	27.75	nw.	8	.....	7	.....	....do	Do.
4:32 p. m..	64.25	8.1	6.20	0.601	0.653	55	78	0.360	27.75	nw.	8	.....	6	.....	....do	Do.
November 19.																
11:42 a. m..	8.24	34.5	1.64	0.842	0.915	56	81	0.360	27.88	sw.	6	.....	6	.....	Partly cloudy.	3 cirro-stratus; 2 alto-cumulus.
3:10 p. m..	43.75	21.1	2.57	0.610	0.663	61	59	0.322	27.84	e.	7	.....	5	.....	....do	5 cirro-stratus; 3 cumulo-stratus.
November 20.																
4:34 p. m..	64.50	7.7	6.55	0.438	0.476	53	83	0.334	27.95	se.	10	.....	6	.....	....do	2 cirrus; 1 cumulo-stratus.
November 21.																
9:37 a. m..	39.75	23.0	2.37	0.758	0.824	56	70	0.316	27.92	nw.	8	.....	6	.....	....do	5 alto-cumulus.
10:09 a. m..	31.75	26.9	2.05	0.948	1.030	58	60	0.282	27.92	nw.	8	.....	6	.....	Light haze ...	1 fracto-cumulus.
10:43 a. m..	23.25	30.4	1.84	0.876	0.952	59	56	0.277	27.92	nw.	9	.....	6	.....	Partly cloudy.	Few cirrus; few fracto-cumulus.
11:39 a. m..	9.25	33.9	1.67	0.740	0.804	60	57	0.298	27.91	nw.	9	.....	5	.....	Cloudy	10 cirro-stratus; solar halo, 22° radius.
12:37 p. m..	5.25	34.3	1.65	0.510	0.554	61	55	0.298	27.89	nw.	7	.....	5	.....	....do	Do.
1:38 p. m..	20.50	31.3	1.79	0.504	0.548	63	53	0.298	27.86	nw.	9	.....	4	.....	....do	10 cirro-stratus.
3:08 p. m..	43.00	21.2	2.56	0.330	0.359	62	54	0.298	27.84	nw.	7	.....	4	.....	....do	Do.
November 26.																
11:39 a. m..	9.50	32.8	1.68	0.899	0.977	58	68	0.322	27.26	w.	3	.....	8	.....	Partly cloudy.	2 cumulus.
1:14 p. m..	14.25	32.0	1.71	0.876	0.952	61	61	0.322	27.21	nw.	4	.....	8	.....	Clear	4 cumulus.
November 28.																
10:12 a. m..	31.50	25.8	2.13	0.730	0.793	34	73	0.143	27.92	nw.	15	.....	3	.....	Partly cloudy.	3 cirro-stratus; few cumulo-stratus.
10:43 a. m..	23.75	28.9	1.92	0.226	0.246	35	69	0.143	27.92	nw.	12	.....	2	.....	Cloudy	10 cirro-stratus; solar halo, 22° radius.
11:42 a. m..	9.00	32.5	1.73	0.816	0.887	38	66	0.150	27.93	nw.	8	.....	4	.....	....do	10 cirrus, in bands.
12:36 p. m..	4.50	33.0	1.71	0.822	0.893	40	61	0.143	27.91	nw.	4	.....	5	.....	....do	10 cirrus.
1:40 p. m..	20.50	29.9	1.86	0.469	0.510	42	51	0.136	27.90	n.	4	.....	5	.....	....do	10 cirro-stratus.
3:08 p. m..	42.50	20.3	2.67	0.604	0.657	46	41	0.124	27.89	s.	2	.....	6	.....	....do	7 cirrus.
4:06 p. m..	57.00	11.7	4.47	0.538	0.585	45	41	0.124	27.88	s.	4	.....	6	.....	Partly cloudy.	Few cirro-stratus near sun.
4:32 p. m..	63.50	7.5	6.66	*0.235	0.255	44	45	0.130	27.88	se.	6	.....	6	.....	....do	Few cirro-stratus in southwest.
November 29.																
†9:14 a. m..	46.00	18.1	2.99	0.609	0.662	39	73	0.172	28.04	s.	12	.....	7	.....	Light smoke..	Few cirrus in southwest.
†9:43 a. m..	38.75	22.1	2.47	0.670	0.728	42	58	0.150	28.04	sc.	12	.....	6	.....	....do	1 cirro-stratus; few alto-stratus.
December 8.																
10:34 a. m..	27.00	26.4	2.10	0.758	0.824	33	59	0.108	28.00	nw.	30	44.8	7	8	Light smoke..	Few fracto-cumulus.
11:31 a. m..	12.75	30.5	1.83	0.755	0.821	34	49	0.108	27.99	nw.	30	45.4	7	8	....do	Few cirrus in west.
12:35 p. m..	3.25	31.6	1.78	0.924	1.004	36	51	0.103	27.97	nw.	25	46.0	7	7	....do	1 cirrus near sun.
1:43 p. m..	20.25	28.7	1.93	0.818	0.889	36	49	0.103	27.96	nw.	25	46.0	6	5	....do	Few cirrus.
3:07 p. m..	41.25	19.8	2.74	0.574	0.624	34	46	0.093	27.95	nw.	25	38.2	5	4	....do	Do.
4:06 p. m..	56.00	11.3	4.63	0.348	0.378	32	43	0.077	27.95	nw.	23	40.0	5	5	Partly cloudy.	1 cirrus near sun.
4:31 p. m..	62.25	7.2	6.89	0.259	0.282	32	45	0.077	27.95	nw.	24	36.3	5	5	....do	Few cirrus near sun.

TABLE 8.—*Pyrheliometer observations at Asheville, N. C.*—Continued.

Date and time (75th meridian time).	Hour angle.	*h.*	*e.*	*Q'.*	*Q.*	*t.*	*R. H.*	*e.*	*B.*	Wind.		*P.*	Sky.	Mt.	Character of sky.	
										Dir.	Vel.				At sun.	In general.
December 9.‡	°	°				°F.	%	*Inch.*	*Inches.*		*M. p. h.*	%				
9:22 a. m.	45.00	17.8	3.04	0.505	0.549	28	66	0.103	28.04	nw.	10	50.5	6	8	Light smoke..	Few cirro-stratus in southwest.
9:40 a. m.	40.50	20.2	2.69	0.552	0.600	30	53	0.089	28.05	nw.	12	48.5	5	8	....do	Few cirrus in southwest.
10:47 a. m.	24.75	27.1	2.04	0.730	0.793	35	48	0.098	28.05	nw.	9	48.6	4	7	....do	1 cirrus well distributed.
11:39 a. m.	10.75	30.7	1.83	0.759	0.825	38	44	0.098	28.04	n.	9	47.0	6	6	....do	2 cirrus in north.
12:43 p. m.	5.25	31.4	1.79	0.686	0.746	41	37	0.093	28.00	n.	12	50.4	6	6	....do	Few cirrus in south.
1:33 p. m.	17.75	29.3	1.90	0.766	0.833	41	34	0.089	27.96	n.	10	53.6	6	4	...do	Few cirrus in southwest.
3:05 p. m.	40.75	20.1	2.58	0.626	0.680	43	36	0.093	27.95	nw.	4	51.6	7	5	....do	Do.
4:02 p. m.	55.00	11.8	4.46	0.480	0.522	42	39	0.103	27.96	nw.	4	47.0	6	4	Partly cloudy.	Fine cirrus over most of sky.
4:31 p. m.	62.25	7.1	6.98	0.274	0.298	40	39	0.093	27.97	nw.	4	42.6	3	4	....do	Do.
December 10.																
11:09 a. m.	18.50	29.0	1.92	0.717	0.779	41	61	0.157	28.06	sw.	5	50.4	7	5	Light smoke..	Few cumulo-stratus.
11:39 a. m.	11.00	30.6	1.84	0.778	0.846	44	52	0.150	28.05	s.	4	49.6	7	5	....do	Do.
12:34 p. m.	2.75	31.4	1.79	0.924	1.043	49	45	0.157	28.03	sw.	4	48.6	6	5	....do	Do.
1:34 p. m.	17.75	29.1	1.91	0.770	0.837	52	44	0.164	27.96	sw.	3	48.1	6	5	....do	Few cirrus; few cumulo-stratus.
3:03 p. m.	40.00	19.0	2.84	0.468	0.509	54	46	0.203	27.93	nw.	4	42.6	6	3	Partly cloudy.	3 cirrus; 2 alto-cumulus.
4:05 p. m.	55.50	11.4	4.59	0.232	0.252	51	51	0.187	27.93	nw.	4	29.5	4	1	Cloudy	Sky nearly overcast with cirrus and cirro-stratus.
December 11.																
9:34 a. m.	42.25	18.9	2.86	0.272	0.296	46	73	0.228	27.94	n.	2	49.1	3	0	Dense smoke..	No clouds visible.
10:34 a. m.	27.25	26.1	2.11	0.525	0.571	54	61	0.256	27.94	sw.	1	46.8	5	0	....do	Do.
11:33 a. m.	12.50	30.2	1.85	0.789	0.858	60	56	0.287	27.91	n.	4	50.9	4	1	Light smoke..	Few cirrus near horizon.
12:34 p. m.	2.75	31.3	1.79	0.572	0.622	62	51	0.277	27.87	n.	3	47.6	5	2	Partly cloudy.	5 cirrus.
1:33 p. m.	17.50	29.1	1.91	0.690	0.750	64	51	0.298	27.83	s.	4	35.4	4	3	....do	6 cirrus.
3:18 p. m.	43.75	18.3	2.94	0.514	0.559	64	42	0.247	27.80	sw.	8	23.2	3	4	Cloudy	10 cirrus; few cumulus.
4:03 p. m.	55.00	11.7	4.46	0.387	0.421	63	43	0.256	27.79	w.	5	22.8	1	4	....do	Do.
4:33 p. m.	62.50	6.9	7.12	0.282	0.307	62	44	0.247	27.78	w.	3	45.8	3	4	...do	6 cirrus.
December 13.																
3:11 p. m.	41.75	19.6	2.73	0.702	0.763	64	55	0.334	27.55	nw.	20	47.1	4	4	Partly cloudy.	2 cumulus; many fine cirrus.
4:05 p. m.	55.25	11.4	4.53	0.422	0.459	60	66	0.334	27.58	nw.	15	50.6	5	4	....do	Few cirrus; few cumulus.
4:35 p. m.	62.75	6.5	7.48	0.222	0.241	58	70	0.322	27.60	nw.	15	46.2	4	3	....do	Few cirrus; few fracto-cumulus.
December 16.																
3:07 p. m.	40.50	19.7	2.73	0.828	0.900	49	69	0.237	27.72	nw.	24	53.8	8	3	Clear	1 cumulo-stratus.
4:03 p. m.	54.75	11.6	4.49	0.676	0.735	49	63	0.219	27.73	nw.	18	51.8	7	3	Light smoke..	Few fracto-cumulus.
4:34 p. m.	62.25	6.7	7.31	0.416	0.452	47	59	0.187	27.73	nw.	16	46.5	6	3	....do	Few fracto-cumulus in south.
December 17.																
9:38 a. m.	42.00	18.8	2.87	0.714	0.776	.....	.....	.....	27.90	nw.	33	48.8	7	10	....do	No clouds.
10:39 a. m.	26.75	25.9	2.12	0.812	0.883	39	48	0.113	27.93	nw.	32	50.9	7	10	....do	Do.
11:40 a. m.	11.50	30.0	1.85	0.869	0.945	40	44	0.113	27.91	nw.	28	51.8	7	9	....do	Do.
12:38 p. m.	3.00	31.0	1.80	0.938	1.020	42	45	0.118	27.90	nw.	25	52.6	8	8	....do	Do.
1:35 p. m.	17.25	29.0	1.91	0.946	1.028	45	42	0.124	27.89	nw.	22	51.5	8	5	....do	Few cirrus in west.
3:08 p. m.	40.50	19.7	2.74	0.794	0.863	46	38	0.113	27.87	nw.	16	48.1	6	4	....do	1 cirrus well distributed.
4:05 p. m.	54.75	11.6	4.51	0.474	0.515	44	41	0.113	27.86	nw.	15	44.4	6	3	....do	Few cirrus in southeast.
4:34 p. m.	62.00	6.9	6.94	0.302	0.328	43	40	0.108	27.86	nw.	14	39.8	6	2	....do	Do.
December 18.																
9:45 a. m.	40.25	19.7	2.74	0.678	0.737	41	42	0.108	27.85	nw.	27	51.4	8	10	....do	No clouds.
10:48 a. m.	24.50	26.6	2.07	0.796	0.865	43	35	0.098	27.86	nw.	23	52.4	8	10	....do	Do.
11:38 a. m.	12.00	29.9	1.86	0.862	0.937	46	35	0.113	27.86	nw.	19	50.2	8	9	....do	Do.
12:38 p. m.	3.00	30.9	1.81	0.814	0.885	47	32	0.103	27.85	nw.	20	51.4	7	8	....do	Do.
1:42 p. m.	19.00	28.3	1.95	0.832	0.904	49	29	0.113	27.83	nw.	23	50.3	8	6	....do	Do.
3:05 p. m.	39.75	20.1	2.69	0.784	0.852	50	28	0.093	27.82	nw.	22	49.6	7	4	....do	Do.
4:07 p. m.	55.25	11.2	4.65	0.468	0.509	48	29	0.098	27.83	nw.	19	45.8	7	3	....do	Do.
4:35 p. m.	62.25	6.7	7.34	0.347	0.377	46	32	0.103	27.83	nw.	16	40.0	6	3	....do	Do.
December 19.																
9:09 a. m.	49.50	14.7	3.62	0.158	0.172	30	83	0.136	27.89	sw.	1	45.4	3	2	Dense smoke..	Do.
9:37 a. m.	42.50	18.6	2.90	0.254	0.276	33	73	0.136	27.89	sw.	1	44.5	5	1	....do	Do.
10:36 a. m.	27.75	25.4	2.16	0.796	0.865	42	51	0.136	27.89	sw.	2	34.3	4	5	Light smoke..	6 cirro-stratus.
11:36 a. m.	12.75	29.7	1.87	0.730	0.793	50	40	0.150	27.88	sw.	4	27.4	3	5	Cloudy	Fine cirro-stratus over most of sky; solar halo, 22° radius.
12:34 p. m.	1.75	30.9	1.80	0.413	0.449	56	35	0.157	27.84	s.	4	20.9	2	4	....do	10 cirro-stratus; solar halo, 22° radius.
1:33 p. m.	16.50	29.0	1.90	0.488	0.530	59	30	0.143	27.81	s.	6	13.8	1	5	....do	Do.
3:02 p. m.	38.75	20.6	2.62	*0.132	0.143	59	30	0.150	27.79	sw.	4	14.4	1	4	....do	Do.
December 22.																
12:49 p. m.	5.25	30.7	1.81	0.725	0.788	41	66	0.172	27.73	nw.	18	40.6	5	3	Light haze....	1 cirrus; 1 cumulo-stratus.
1:37 p. m.	17.25	28.7	1.92	0.724	0.787	41	66	0.172	27.72	nw.	16	39.4	6	2	....do	Do.
4:07 p. m.	54.25	11.7	4.45	0.318	0.346	39	70	0.164	27.76	nw.	20	3.0	0	0	....do	9 cumulo-stratus.
December 23.																
11:56 a. m.	8.25	30.4	1.83	0.776	0.843	42	77	0.211	27.88	nw.	14	17.1	6	1	Partly cloudy.	1 cirrus; 7 cumulo-stratus.
12:50 p. m.	5.25	30.7	1.82	0.737	0.801	43	72	0.187	27.86	nw.	16	36.8	7	1	....do	Few cirrus; 6 cumulo-stratus.
1:35 p. m.	16.50	28.9	1.92	0.704	0.765	42	69	0.187	27.86	nw.	16	39.6	7	1	Light haze....	Few cirrus; 2 cumulo-stratus.
3:04 p. m.	38.75	20.5	2.63	0.606	0.659	42	68	0.187	27.87	nw.	16	44.2	8	2	....do	Few fracto-cumulus.
4:04 p. m.	53.75	12.1	4.32	0.411	0.447	41	67	0.172	27.88	nw.	16	42.0	7	3	....do	Do.
4:33 p. m.	61.00	7.4	6.70	0.269	0.292	40	67	0.164	27.88	nw.	10	36.1	5	2	....do	Do.
December 30.																
9:08 a. m.	51.00	13.9	3.81	0.602	0.654	34	48	0.093	27.96	nw.	15	55.2	8	10	Light smoke..	No clouds.
10:03 a. m.	37.25	21.4	2.54	0.667	0.725	38	38	0.085	27.97	nw.	15	55.7	9	10	....do	Few cirro-stratus in west.
10:38 a. m.	28.50	25.3	2.18	0.785	0.853	38	36	0.081	27.98	nw.	15	55.4	8	9	....do	Do.
11:40 a. m.	13.00	29.9	1.87	0.738	0.802	40	40	0.098	27.98	nw.	20	55.6	8	8	Partly cloudy.	6 cirrus.
12:45 p. m.	3.00	31.1	1.80	0.912	0.991	42	39	0.103	27.98	nw.	15	18.4	1	8	Light smoke..	5 cirrus.
1:38 p. m.	16.50	29.1	1.91	0.867	0.942	44	42	0.118	27.95	nw.	15	54.8	9	6	....do	1 cirrus.
3:06 p. m.	38.50	20.8	2.77	0.852	0.926	42	40	0.108	27.95	nw.	15	54.9	9	4	....do	Do.
4:05 p. m.	53.25	12.4	4.24	0.517	0.562	41	39	0.098	27.95	nw.	10	39.2	4	3	Partly cloudy.	Few cirrus; 1 cirro-stratus.
December 31.																
9:41 a. m.	43.00	18.4	2.94	0.239	0.260	33	70	0.130	28.02	sw.	2	40.8	3	1	Cloudy	Fine cirrus over most of sky.
10:36 a. m.	29.25	25.1	2.19	0.716	0.778	39	50	0.118	28.05	s.	4	45.6	3	2	....do	Do.
11:37 a. m.	6.50	30.9	1.82	0.794	0.863	44	48	0.136	28.03	s.	3	45.1	5	5	Partly cloudy.	3 cirrus.
12:45 p. m.	3.00	31.2	1.80	0.870	0.946	49	31	0.108	28.00	s.	4	49.6	8	4	Light haze....	1 cirrus in southeast.
1:35 p. m.	15.50	29.4	1.90	0.797	0.866	50	32	0.113	27.97	sw.	4	49.0	8	4	....do	No clouds.
3:06 p. m.	38.25	21.0	2.59	0.644	0.700	51	33	0.124	27.95	sw.	3	49.4	8	3	....do	Few cirrus in south.
4:05 p. m.	53.00	12.8	4.11	0.498	0.541	50	32	0.118	27.95	sw.	4	46.8	7	3	....do	Do.
January 3.																
1:05 p. m.	8.00	31.0	1.77	*0.737	0.801	45	72	0.219	27.51	n.	24	7.2	0	6	Partly cloudy.	1 cirrus; 8 cumulo-stratus.
January 5.																
10:57 a. m.	24.50	27.2	2.00	0.689	0.749	41	70	0.180	27.53	s.	12	18.2	9	6	....do	1 alto-cumulus; 3 cumulo-stratus.
11:46 a. m.	12.25	30.6	1.80	0.734	0.798	40	68	0.164	27.51	se.	12	5.8	9	5	....do	4 cumulo-stratus.
12:36 p. m.	0.25	31.7	1.74	0.740	0.804	42	64	0.172	27.47	se.	10	26.2	6	2	....do	1 cirro-cumulus; 3 cumulo-stratus.
January 6.																
9:36 a. m.	45.00	17.9	2.96	0.366	0.398	27	73	0.108	27.54	nw.	24	30.3	6	0	....do	4 cumulo-stratus.
10:59 a. m.	24.25	27.4	1.99	0.413	0.449	29	70	0.108	27.55	nw.	20	0.0	0	0	....do	4 cumulo-stratus; light snow falling.
1:50 p. m.	18.50	29.2	1.88	0.505	0.549	28	76	0.113	27.52	nw.	15	29.6	5	1	....do	5 cumulo-stratus; light snow falling.
3:08 p. m.	38.00	21.8	2.46	0.414	0.450	30	68	0.108	27.53	nw.	24	30.8	8	1	Light haze....	1 cumulo-stratus.
4:03 p. m.	54.75	12.1	4.27	0.340	0.370	27	67	0.093	27.55	n.	15	27.2	5	2	....do	2 cumulo-stratus.
January 7.																
9:38 a. m.	44.50	18.3	2.88	0.260	0.283	38	67	0.157	27.25	se	4	12.4	1	2	Cloudy	10 cirro-stratus.
10:37 a. m.	29.75	25.5	2.10	0.458	0.498	43	54	0.150	27.25	sw.	7	38.0	7	8	....do	1 cirro-stratus; few cumulo-stratus; many fine cirrus.
11:36 a. m.	15.00	30.2	1.80	0.648	0.704	43	50	0.136	27.21	sw.	24	39.3	7	8	Partly cloudy.	4 cirro-stratus; few cumulo-stratus.

TABLE 8.—*Pyrheliometer observations at Asheville, N. C.*—Continued.

Date and time (75th meridian time).	Hour angle.	*h.*	*e.*	*Q'.*	*Q.*	*t.*	*R. H.*	*e.*	*B.*	Wind.		*P.*	Sky.	Mt.	Character of sky.	
										Dir.	Vel.				At sun.	In general.
	°	°				°F.	%.	*Inch.*	*Inches.*		*M. p. h.*	%.				
Jan. 7—*Cont'd.*																
12:35 p. m..	0. 25	31. 9	1. 71	0. 756	0. 822	43	48	0. 130	27. 18	sw.	22	40. 4	7	7	Light haze....	Few cirro-stratus; few fracto-cumulus.
1:36 p. m..	15. 00	30. 2	1. 80	0. 764	0. 830	45	47	0. 143	27. 16	sw.	24	39. 3	7	5	....do	Few cumulo-stratus; few fracto-cumulus.
3:15 p. m..	32. 25	24. 5	2. 18	0. 154	0. 167	42	54	0. 150	27. 17	sw.	20	5. 8	0	0	Cloudy	6 alto-stratus; 4 cumulo-stratus.
January 8.																
12:34 p. m..	0. 50	32. 0	1. 73	0. 728	0. 791	23	66	0. 077	27. 49	nw.	15	32. 3	9	8	Light haze....	1 cumulo-stratus.
1:34 p. m..	14. 50	30. 5	1. 80	0. 748	0. 813	23	76	0. 089	27. 46	nw.	20	22. 2	8	5	....do	Do.
3:07 p. m..	37. 75	22. 0	2. 46	0. 610	0. 663	23	64	0. 077	27. 46	nw.	20	37. 8	8	4	....do	Do.
4:07 p. m..	52. 75	13. 6	3. 82	0. 348	0. 378	22	64	0. 074	27. 46	nw.	22	38. 5	8	4	....do	Few cumulo-stratus.
4:35 p. m..	59. 75	9. 1	5. 54	0. 258	0. 280	22	58	0. 070	27. 47	nw.	23	35. 5	6	3	....do	1 cumulo-stratus.
January 9.																
9:10 a. m..	51. 75	14. 3	3. 68	0. 410	0. 446	20	62	0. 063	27. 68	n.	15	42. 4	9	10	Light smoke..	Few cirrus in southwest.
9:39 a. m..	44. 50	18. 5	2. 89	0. 525	0. 571	21	56	0. 063	27. 68	n.	15	44. 0	9	10	....do	Do.
10:34 a. m..	30. 75	25. 3	2. 16	0. 680	0. 739	25	59	0. 081	27. 67	nw.	12	43. 7	9	10	....do	Few cirrus in south.
11:40 a. m..	14. 25	30. 6	1. 81	0. 668	0. 726	27	60	0. 085	27. 65	n.	13	44. 5	9	10	....do	Do.
12:40 p. m..	0. 75	32. 2	1. 72	0. 708	0. 770	31	55	0. 093	27. 60	n.	20	45. 2	9	8	....do	Few cirrus; few cumulo-stratus in south.
1:35 p. m..	14. 50	30. 6	1. 81	0. 761	0. 827	34	47	0. 093	27. 57	n.	15	47. 2	9	6	....do	Few cumulo-stratus in south.
3:06 p. m..	37. 25	22. 3	2. 41	0. 745	0. 810	35	32	0. 063	27. 56	n.	15	49. 8	9	4	....do	Few cirrus and few cumulo-stratus in south.
4:06 p. m..	52. 25	14. 0	3. 73	0. 483	0. 525	36	35	0. 070	27. 56	n.	9	48. 2	8	3	....do	Few cirrus in south.
4:35 p. m..	59. 50	9. 3	5. 46	0. 365	0. 397	35	32	0. 063	27. 56	n.	9	45. 4	8	3	....do	Do.
January 10.																
10:47 a. m..	27. 50	26. 7	2. 05	0. 274	0. 298	32	41	0. 077	27. 81	nw.	9	32. 7	8	9	Partly cloudy.	4 cirrus; 4 alto-stratus.
11:35 a. m..	15. 50	30. 5	1. 82	0. 772	0. 839	35	41	0. 081	27. 80	nw.	10	44. 2	8	9	Light smoke..	1 cirrus on horizon.
12:34 p. m..	0. 75	32. 3	1. 73	0. 790	0. 859	36	42	0. 089	27. 78	nw.	9	36. 3	5	7	Light haze....	2 cirrus.
1:36 p. m..	14. 75	30. 7	1. 81	0. 374	0. 407	40	40	0. 098	27. 76	nw.	6	3. 3	1	7	Partly cloudy.	4 cirrus; 4 alto-cumulus.
3:03 p. m..	36. 50	22. 8	2. 37	0. 566	0. 615	40	38	0. 093	27. 72	sw.	3	43. 8	8	4	Light haze....	3 alto-cumulus.
4:04 p. m..	51. 75	14. 4	3. 66	0. 377	0. 410	41	36	0. 093	27. 71	sw.	2	41. 0	5	1	....do	Few cirrus; 1 alto-stratus in west.
January 12.																
9:11 a. m..	51. 75	14. 6	3. 62	0. 454	0. 493	15	72	0. 057	27. 80	nw.	22	47. 7	8	10	Clear	Few cumulo-stratus.
9:46 a. m..	43. 00	19. 6	2. 75	0. 542	0. 589	16	68	0. 057	27. 82	nw.	20	46. 9	8	10	Light smoke..	Do.
10:35 a. m..	30. 75	25. 7	2. 13	0. 766	0. 833	19	67	0. 066	27. 83	nw.	22	47. 8	8	10	....do	Do.
11:38 a. m..	15. 00	30. 9	1. 80	0. 821	0. 892	21	63	0. 066	27. 83	nw.	21	48. 0	8	9	....do	Few fracto-cumulus.
12:36 p. m..	0. 50	32. 6	1. 72	0. 826	0. 898	22	64	0. 070	27. 82	nw.	20	46. 4	8	9	....do	Do.
1:34 p. m..	14. 00	31. 1	1. 79	0. 784	0. 852	23	62	0. 074	27. 82	nw.	16	46. 0	8	6	....do	Few cumulo-stratus on horizon.
3:09 p. m..	37. 25	22. 6	2. 40	0. 592	0. 643	22	61	0. 070	27. 82	nw.	24	42. 4	7	4	....do	Do.
4:05 p. m..	51. 75	14. 6	3. 63	0. 475	0. 516	20	58	0. 062	27. 84	nw.	15	39. 7	7	3	....do	Few cumulo-stratus in east.
4:36 p. m..	59. 50	9. 6	5. 37	0. 296	0. 322	19	57	0. 057	27. 85	nw.	12	35. 0	7	3	....do	Few cumulo-stratus in west.
January 13.																
9:10 a. m..	52. 25	14. 4	3. 70	0. 382	0. 415	16	68	0. 057	28. 03	nw.	10	49. 3	9	10	....do	Few alto-stratus in south.
9:45 a. m..	43. 50	19. 5	2. 78	0. 644	0. 700	18	56	0. 057	28. 03	nw.	11	51. 2	9	10	....do	Do.
10:34 a. m..	31. 25	25. 5	2. 16	0. 794	0. 863	20	55	0. 057	28. 02	nw.	12	51. 8	9	10	....do	Few alto-stratus in southwest.
11:44 a. m..	13. 75	31. 4	1. 79	0. 762	0. 828	26	43	0. 060	28. 01	nw.	12	51. 2	9	9	....do	1 cirrus near sun.
12:36 p. m..	0. 75	32. 8	1. 72	0. 770	0. 837	28	45	0. 070	28. 00	nw.	12	51. 8	9	7	....do	Do.
1:36 p. m..	13. 25	31. 3	1. 80	0. 704	0. 765	31	50	0. 085	27. 98	nw.	10	49. 6	8	5	Partly cloudy.	6 cirrus.
3:05 p. m..	36. 50	23. 1	2. 36	0. 688	0. 748	33	37	0. 066	27. 96	nw.	6	49. 2	8	4	Light smoke..	Few cirrus on horizon.
4:05 p. m..	51. 50	14. 8	3. 58	0. 556	0. 604	32	38	0. 066	27. 96	nw.	7	45. 4	8	4	...do	Few cirrus in south.
4:34 p. m..	58. 75	10. 2	5. 10	0. 388	0. 422	31	31	0. 052	27. 96	nw.	8	42. 9	7	3	....do	No clouds.
January 15.																
9:09 a. m..	52. 50	14. 5	3. 70	0. 206	0. 224	31	70	0. 118	27. 88	nw.	3	40. 0	6	7	Partly cloudy.	2 cirrus.
9:38 a. m..	45. 25	18. 9	2. 85	0. 340	0. 370	33	63	0. 118	27. 88	nw.	6	43. 1	7	7	....do	Do.
10:35 a. m .	31. 00	26. 0	2. 11	0. 532	0. 578	39	57	0. 136	27. 88	nw.	7	44. 1	7	8	....do	5 cirrus.
11:38 a. m..	15. 25	31. 3	1. 79	0. 814	0. 885	43	50	0. 143	27. 86	nw.	7	45. 8	7	8	Light smoke..	1 cirrus in southeast.
12:34 p. m..	1. 25	33. 1	1. 69	0. 811	0. 882	43	51	0. 143	27. 86	nw.	14	46. 2	7	7	....do	Few cirrus on horizon.
1:34 p. m .	13. 75	31. 7	1. 77	0. 822	0. 893	46	48	0. 143	27. 84	nw.	12	46. 2	7	5	....do	No clouds.
3:08 p. m..	37. 25	23. 1	2. 35	0. 642	0. 698	46	45	0. 136	27. 82	n.	20	45. 2	7	4	Dense smoke..	Do.
4:04 p. m..	51. 25	15. 3	3. 47	0. 518	0. 563	44	45	0. 130	27. 81	n.	18	42. 0	7	3	Light smoke..	Do.
4:34 p. m..	58. 75	10. 5	4. 94	0. 379	0. 412	43	45	0. 124	27. 81	n.	20	38. 6	6	3	....do	Do.
January 16.																
9:10 a. m..	52. 50	14. 6	3. 63	0. 116	0. 126	32	77	0. 136	27. 83	n.	3	17. 4	2	1	Cloudy	10 cirrus.
9:38 a. m..	45. 50	19. 0	2. 83	*0. 107	0. 116	34	85	0. 164	27. 85	n.	2	6. 3	1	4	....do	Do.
1:33 p. m..	13. 25	32. 0	1. 74	0. 546	0. 593	47	51	0. 164	27. 77	nw.	3	16. 0	3	4	....do	9 cirrus; 1 alto-cumulus.
January 17.																
10:41 a. m..	29. 75	26. 9	2. 03	0. 647	0. 703	46	54	0. 164	27. 61	nw.	15	42. 8	6	8	Partly cloudy.	9 alto-stratus.
11:39 a. m..	15. 25	31. 7	1. 75	0. 838	0. 911	48	54	0. 180	27. 60	n.	15	47. 8	6	5	Light smoke..	Few cirrus; few cumulo-stratus on horizon.
12:38 p. m..	0. 50	33. 6	1. 66	0. 765	0. 832	50	52	0. 187	27. 58	nw.	12	43. 0	6	5	Partly cloudy.	1 cirrus; few alto-stratus; few cumulo-stratus.
3:03 p. m..	35. 75	24. 0	2. 24	0. 790	0. 859	54	52	0. 211	27. 51	nw.	13	15. 2	1	4	Light smoke..	7 alto-cumulus.
4:02 p. m..	50. 50	15. 9	3. 31	*0. 184	0. 200	51	57	0. 211	27. 51	nw.	18	18. 2	3	2	Partly cloudy.	7 cirrus; 1 alto-cumulus.
January 19.																
9:09 a. m..	53. 00	14. 7	3. 63	0. 575	0. 625	25	58	0. 089	27. 98	se.	18	48. 7	8	9	Light smoke..	No clouds.
9:35 a. m..	46. 50	18. 7	2. 89	0. 522	0. 567	26	49	0. 066	27. 99	se.	18	48. 4	8	10	....do	Do.
10:34 a. m..	31. 75	26. 3	2. 08	0. 703	0. 764	30	41	0. 066	28. 00	se.	7	50. 5	8	10	....do	Do.
11:36 a. m..	16. 25	31. 9	1. 76	0. 790	0. 859	31	37	0. 063	28. 01	se.	9	50. 5	9	9	....do	Do.
12:34 p. m..	1. 75	33. 9	1. 68	0. 776	0. 843	34	35	0. 063	28. 00	se.	13	49. 9	9	6	... do	Do.
1:33 p. m..	13. 00	32. 6	1. 73	0. 770	0. 837	35	35	0. 074	27. 97	se.	12	48. 8	8	5	....do	Do.
3:04 p. m..	35. 75	24. 5	2. 24	0. 679	0. 738	37	42	0. 089	27. 92	se.	10	48. 6	8	4	...do	Do.
4:04 p. m..	50. 75	16. 1	3. 32	0. 477	0. 518	37	35	0. 081	27. 92	se.	8	46. 8	8	4	....do	Do.
4:35 p. m..	58. 50	11. 2	4. 66	0. 336	0. 365	36	35	0. 074	27. 92	se.	7	43. 6	7	4	... do	Do.
January 22.																
9:43 a. m..	44. 75	20. 5	2. 63	0. 546	0. 593	35	74	0. 150	27. 76	n.	15	31. 8	7	6	Partly cloudy.	3 cirrus; 1 cumulo-stratus.
10:31 a. m..	32. 75	26. 5	2. 07	0. 212	0. 230	36	75	0. 157	27. 76	nw.	18	12. 2	1	5	....do	9 alto-stratus; 1 cumulo-stratus.
11:33 a. m..	17. 25	32. 2	1. 74	0. 624	0. 678	38	67	0. 150	27. 76	n.	12	13. 0	1	3	....do	9 alto-stratus.
12:39 p. m..	0. 75	34. 6	1. 63	0. 212	0. 230	40	65	0. 164	27. 75	nw.	12	13. 8	2	3	Cloudy	9 cirrus.
1:31 p. m..	12. 25	33. 4	1. 68	0. 810	0. 880	42	62	0. 164	27. 72	n.	10	25. 6	5	3	Partly cloudy.	6 cirrus.
3:04 p. m..	35. 50	25. 1	2. 17	0. 606	0. 659	41	57	0. 143	27. 70	nw.	11	41. 8	6	2	Light smoke..	1 cirrus near sun.
4:06 p. m..	51. 00	16. 4	3. 24	0. 324	0. 352	41	51	0. 136	27. 71	nw.	15	40. 6	6	2	Dense smoke..	Few cirrus.
5:00 p. m..	64. 50	7. 6	6. 58	0. 234	0. 254	40	52	0. 124	27. 73	nw.	12	32. 2	5	2	Light smoke..	No clouds.
January 23.																
9:13 a. m..	52. 25	15. 9	3. 36	0. 286	0. 311	33	79	0. 150	27. 89	n.	2	44. 9	6	1	Light smoke..	Few cirrus; few alto-stratus.
9:39 a. m..	45. 75	19. 9	2. 71	0. 351	0. 382	33	72	0. 136	27. 90	n.	2	45. 2	6	2	....do	Few alto-stratus.
10:35 a. m..	31. 75	27. 1	2. 03	0. 542	0. 589	40	66	0. 164	27. 90	sw.	2	44. 8	6	2	....do	Few alto-cumulus in north.
11:35 a. m..	16. 75	32. 5	1. 72	0. 613	0. 666	44	60	0. 180	27. 89	nw.	2	46. 2	7	2	....do	Do.
12:34 p. m..	2. 00	34. 7	1. 63	0. 736	0. 800	47	53	0. 172	27. 87	nw.	5	38. 8	6	3	....do	5 alto-cumulus.
1:34 p. m..	13. 00	33. 7	1. 67	0. 680	0. 739	50	54	0. 195	27. 84	nw.	4	46. 8	7	2	Partly cloudy.	Few alto-cumulus; few alto-stratus; coronal bands.
3:04 p. m..	35. 50	25. 3	2. 16	0. 598	0. 650	50	53	0. 195	27. 80	w.	3	45. 2	7	2	Light smoke..	Few alto-cumulus.
4:04 p. m..	50. 50	17. 0	3. 14	0. 358	0. 389	50	45	0. 164	27. 79	ne.	3	40. 0	6	1	....do	Few cirrus; few alto-cumulus.
January 26.																
11:34 a. m..	17. 25	33. 1	1. 70	0. 301	0. 327	44	84	0. 247	27. 98	s.	7	10. 3	1	6	Cloudy	10 cirro-stratus.
12:32 p. m..	2. 75	35. 4	1. 60	0. 709	0. 771	49	71	0. 247	27. 96	s.	6	13. 2	2	6	....do	5 cirrus; 5 cirro-stratus.
1:34 p. m..	12. 75	34. 2	1. 65	0. 638	0. 693	55	56	0. 247	27. 93	s.	6	12. 2	2	5	....do	10 cirro-stratus.
3:12 p. m..	37. 25	24. 9	2. 20	0. 476	0. 517	55	46	0. 195	27. 91	se.	15	37. 0	9	4	Partly cloudy.	9 alto-stratus.
4:04 p. m..	50. 25	17. 6	3. 05	*0. 604	0. 657	53	44	0. 180	27. 91	se.	12	41. 0	5	4	....do	8 cirrus; 1 alto-stratus.
5:10 p. m..	66. 75	6. 6	7. 46	0. 172	0. 187	46	70	0. 219	27. 96	s.	12	11. 0	1	5	Light smoke..	1 cirrus; 10 cumulus; 7 alto-stratus.
January 28.																
10:48 a. m..	28. 75	29. 5	1. 89	0. 410	0. 446	49	93	0. 322	27. 82	n.	5	22. 2	4	2	Partly cloudy.	4 cirrus; 5 cirro-stratus; 1 stratus.
11:35 a. m..	17. 00	33. 7	1. 67	0. 478	0. 520	56	80	0. 360	27. 81	n.	2	9. 4	1	2	....do	10 cirro-stratus; solar halo, 22° radius.

TABLE 8.—*Pyrheliometer observations at Asheville, N. C.*—Continued.

Date and time (75th meridian time).	Hour angle.	*h.*	ε.	*Q'.*	*Q.*	*t.*	*R. H.*	*e.*	*B.*	Wind.		*P.*	Sky.	Mt.	Character of sky.	
										Dir.	Vel.				At sun.	In general.
January 29.	°	°				°F.	%	*Inch.*	*Inches.*		*M. p. h.*	%				
9:14 a. m..	52.25	17.0	3.12	0.264	0.287	52	91	0.360	27.61	s.	4	17.2	2	0	Cloudy	9 cirrus; 1 stratus.
9:37 a. m..	46.50	20.5	2.61	0.272	0.296	54	86	0.360	27.61	se.	6	18.6	2	0	....do	Do.
11:25 a. m..	19.50	33.2	1.68	0.124	0.135	59	79	0.387	27.56	se.	8	8.6	0	5	....do	10 alto-stratus.
12:35 p. m..	2.00	36.2	1.56	0.110	0.120	60	78	0.402	27.56	se.	12	7.9	0	6	....do	Do.
1:39 p. m..	14.00	34.7	1.61	0.562	0.611	63	70	0.402	27.52	se.	12	13.2	1	5	....do	9 cirrus; few alto-stratus.
3:06 p. m..	35.75	26.5	2.05	0.211	0.229	62	74	0.417	27.50	se.	13	17.8	3	3	....do	9 cirrus; few cumulo-stratus.
4:10 p. m..	51.75	17.3	3.06	0.222	0.241	62	74	0.417	27.50	se.	13	15.2	1	3	....do	10 cirro-stratus; few cumulo-stratus.
5:03 p. m..	65.00	8.2	6.07	0.072	0.078	60	75	0.402	27.50	se.	12	16.8	1	3	....do	Do.
January 30.																
9:16 a. m..	51.75	17.5	3.05	0.352	0.383	35	74	0.150	27.72	nw.	24	39.4	7	10	Partly cloudy.	1 alto-stratus; few cumulus.
10:37 a. m..	31.50	28.8	1.92	0.662	0.720	36	62	0.130	27.75	nw.	30	41.0	7	8	Dense smoke..	Few cirrus; few cumulo-stratus.
11:44 a. m..	14.75	34.8	1.62	0.757	0.823	38	60	0.136	27.76	nw.	25	42.2	8	8	Light smoke..	Few fracto-cumulus.
12:34 p. m..	2.25	36.5	1.56	0.724	0.787	40	58	0.143	27.77	nw.	24	43.5	8	9	....do	Do.
1:58 p. m..	18.75	33.7	1.67	0.771	0.838	40	46	0.113	27.77	nw.	22	43.2	8	5	....do	No clouds.
3:08 p. m..	36.25	26.5	2.07	0.718	0.780	42	38	0.098	27.77	nw.	18	41.2	8	4	....do	Do.
4:03 p. m..	50.00	18.6	2.89	0.578	0.628	42	39	0.098	27.80	nw.	18	39.2	8	3	....do	Do.
5:04 p. m..	65.25	8.3	6.08	0.250	0.272	38	36	0.085	27.81	nw.	17	31.6	7	3	....do	Few cirrus.
5:32 p. m..	72.25	3.3	13.00	0.141	0.153	37	39	0.081	27.82	nw.	12	31.5	6	.....	....do	Do.
January 31.																
9:26 a. m..	49.50	19.1	2.84	0.524	0.570	33	64	0.103	27.99	nw.	7	43.3	8	10	Partly cloudy.	7 cirrus.
10:35 a. m..	32.25	28.7	1.94	0.685	0.745	36	52	0.108	28.00	nw.	5	44.0	8	10	Light smoke..	1 cirrus near sun.
11:46 a. m..	14.50	35.1	1.62	0.784	0.852	43	41	0.113	27.99	nw.	5	38.0	4	8	Dense smoke..	1 cirrus; 2 cirro-stratus near sun.
12:37 p. m..	1.75	36.7	1.56	0.684	0.743	47	35	0.118	27.96	nw.	6	20.2	3	6	Cloudy	10 cirro-stratus.
1:35 p. m..	12.75	35.5	1.60	0.344	0.374	48	35	0.113	27.93	nw.	4	17.8	2	4	....do	10 cirro-stratus; solar halo, 22° radius.
3:07 p. m..	35.75	27.0	2.04	0.215	0.234	51	32	0.113	27.91	nw.	4	12.4	1	4	....do	Do.
4:03 p. m..	49.75	18.9	2.85	0.033	0.036	50	32	0.118	27.91	nw.	3	7.4	0	4	....do	10 cirro-stratus; no shadow.
5:05 p. m..	65.25	8.4	6.04	0.001	0.001	48	29	0.098	27.90	nw.	3	7.8	0	3	....do	10 alto-stratus; no shadow.
5:28 p. m..	71.00	4.3	10.70	0.001	0.001	.....	.....	.....	27.90	w.	2	.....	0	3	....do	Do.
February 4.																
9:33 a. m..	47.75	21.2	2.40	0.361	0.392	59	52	0.266	27.32	w.	10	18.2	8	10	Partly cloudy.	9 alto-stratus.
10:37 a. m..	31.75	29.9	1.83	0.058	0.063	58	23	0.113	27.32	w.	18	28.7	9	10	Cloudy	Few cirrus; 5 alto-stratus.
11:53 a. m..	12.75	36.6	1.52	0.036	0.039	57	32	0.150	27.31	nw.	8	45.8	8	10	....do	1 alto-stratus; no shadow.
12:37 p. m..	1.75	37.9	1.49	1.026	1.115	59	22	0.108	27.31	sw.	23	47.4	8	9	Clear	Few alto-stratus in southeast.
1:36 p. m..	13.00	36.6	1.52	0.971	1.055	57	25	0.113	27.27	sw.	23	46.6	8	7	....do	Few alto-stratus.
3:01 p. m..	34.25	28.7	1.89	0.888	0.965	57	21	0.098	27.27	sw.	20	47.0	9	4	Light smoke..	Do.
4:06 p. m..	50.50	19.4	2.73	0.698	0.759	56	22	0.098	27.29	sw.	15	45.2	8	4	....do	Few alto-stratus in south.
5:01 p. m..	64.25	9.9	5.12	0.460	0.500	53	17	0.070	27.30	sw.	18	40.2	7	4	....do	Do.
5:44 p. m..	75.00	2.1	16.90	0.106	0.115	49	24	0.081	27.32	w.	20	37.5	6	.....	....do	Do.
February 5.																
10:28 a. m..	34.00	29.0	1.91	0.464	0.504	27	64	0.093	27.87	nw.	30	31.4	5	5	Partly cloudy.	5 cirro-stratus; light snow.
12:40 p. m..	1.00	38.2	1.51	0.906	0.985	32	66	0.124	27.88	nw.	23	47.5	7	4	Light smoke..	Few fracto-cumulus.
1:36 p. m..	13.00	36.9	1.55	0.858	0.933	33	63	0.118	27.86	nw.	19	47.9	7	4	Dense smoke..	Few alto-stratus; few cumulo-stratus.
3:05 p. m..	35.25	28.4	1.96	0.809	0.879	35	56	0.113	27.87	nw.	25	48.0	8	3	....do	Few cirrus.
4:11 p. m..	51.75	18.8	2.86	0.688	0.748	34	60	0.113	27.88	nw.	24	46.2	7	.....	Light smoke..	No clouds.
February 6.																
9:15 a. m..	52.25	18.7	2.90	0.019	0.021	29	72	0.113	28.02	nw.	1	15.0	2	1	Cloudy	10 alto-cumulus; no shadow.
11:06 a. m..	24.50	33.7	1.69	0.003	0.003	35	54	0.113	28.02	e.	2	4.2	1	1	....do	10 alto-stratus; no shadow.
12:49 p. m..	1.25	38.5	1.49	0.054	0.059	43	43	0.118	27.96	e.	3	4.5	0	2	....do	Do.
1:32 p. m..	12.00	37.4	1.53	0.002	0.002	44	42	0.124	27.93	s.	4	5.2	0	2	....do	Do.
February 9.																
9:41 a. m..	45.75	23.5	2.32	0.608	0.661	34	76	0.150	27.91	nw.	23	38.5	7	4	Light smoke..	Few cumulo-stratus in west.
10:35 a. m..	32.25	31.0	1.80	0.654	0.711	36	72	0.157	27.93	nw.	15	40.3	8	4	....do	No clouds.
11:35 a. m..	17.25	37.0	1.55	0.734	0.798	40	67	0.164	27.95	nw.	15	40.4	8	3	....do	Do.
12:34 p. m..	2.50	39.4	1.48	0.708	0.770	43	60	0.172	27.94	nw.	20	41.6	8	3	....do	Do.
1:35 p. m..	12.75	38.1	1.51	0.750	0.815	45	58	0.180	27.91	nw.	15	41.4	8	3	....do	Do.
3:05 p. m..	35.25	29.5	1.88	0.650	0.707	47	48	0.157	27.89	nw.	12	41.2	8	3	Partly cloudy.	1 cirrus.
4:05 p. m..	50.25	20.7	2.62	0.398	0.433	48	40	0.130	27.90	nw.	12	36.0	6	3	....do	5 cirro-stratus.
5:03 p. m..	64.75	10.6	4.91	0.214	0.233	45	50	0.150	27.91	n.	5	24.8	5	3	....do	9 cirro-stratus.
5:48 p. m..	76.00	2.4	16.10	0.029	0.032	43	54	0.150	27.91	nw.	7	28.2	4	.....	Cloudy	Do.
February 10.																
10:38 a. m..	31.50	31.6	1.78	0.014	0.015	44	60	0.172	27.98	se.	12	3.4	0	3	....do	10 alto-stratus; no shadow.
February 11.																
3:14 p. m..	37.50	28.8	1.89	0.786	0.854	58	48	0.228	27.36	sw.	15	34.0	9	3	Light smoke..	4 cumulus near sun.
4:05 p. m..	50.25	21.2	2.51	0.573	0.623	56	48	0.211	27.38	sw.	16	28.2	9	3	....do	Do.
5:00 p. m..	64.00	11.6	4.43	0.123	0.134	54	50	0.211	27.41	nw.	18	.....	0	3	Partly cloudy.	9 cumulo-stratus.
February 12.																
9:12 a. m..	53.00	19.6	2.75	0.357	0.388	38	90	0.211	27.81	nw.	2	45.0	9	4	Light smoke..	No clouds.
10:34 a. m..	32.50	31.4	1.77	0.594	0.646	44	79	0.228	27.81	nw.	2	46.1	9	6	....do	Do.
11:34 a. m..	17.50	37.8	1.51	0.698	0.759	49	69	0.237	27.80	sw.	3	46.3	8	6	....do	Do.
12:35 p. m..	2.25	40.4	1.43	0.856	0.930	57	56	0.256	27.79	sw.	2	47.6	8	6	....do	Do.
1:35 p. m..	12.75	39.0	1.47	0.927	1.008	61	39	0.203	27.75	se.	7	49.1	8	6	....do	Do.
3:05 p. m..	35.25	30.3	1.82	0.900	0.978	63	24	0.136	27.70	se.	15	49.5	8	4	....do	Do.
4:03 p. m..	49.75	21.7	2.49	0.806	0.876	60	28	0.143	27.71	s.	18	48.2	8	4	....do	Do.
5:04 p. m..	65.00	11.0	4.71	0.575	0.625	59	24	0.113	27.72	se.	14	43.4	7	3	....do	Do.
5:49 p. m..	76.25	2.8	14.60	0.162	0.176	56	36	0.172	27.72	se.	12	.....	.....	.....	....do	Do.
February 13.																
9:16 a. m..	52.00	2.5	2.64	0.495	0.538	38	78	0.180	27.89	n.	4	49.2	8	3	Partly cloudy.	1 cirrus.
10:33 a. m..	32.75	31.9	1.75	0.676	0.735	48	65	0.219	27.89	calm.	.....	47.4	6	3	Light smoke..	Do.
11:34 a. m..	17.50	38.1	1.51	0.958	1.041	58	53	0.256	27.88	nw.	9	51.4	9	5	....do	Do.
12:34 p. m..	2.50	40.7	1.42	1.036	1.126	61	50	0.277	27.87	nw.	10	51.8	8	5	....do	No clouds.
1:34 p. m..	12.50	39.4	1.46	1.000	1.087	62	40	0.219	27.86	nw.	6	51.8	9	4	....do	Do.
3:04 p. m..	35.00	30.7	1.81	0.867	0.942	64	34	0.211	27.82	nw.	3	51.0	8	3	....do	Do.
4:04 p. m..	50.00	21.8	2.48	0.570	0.620	66	37	0.266	27.82	w.	1	49.1	7	3	....do	Do.
5:04 p. m..	65.00	11.3	4.61	0.314	0.341	64	42	0.247	27.83	w.	2	46.0	6	3	....do	Do.
5:58 p. m..	78.50	1.3	22.00	0.062	0.067	60	46	0.237	27.84	sw.	1	47.9	6	.....	....do	Do.
February 14.																
9:10 a. m..	53.50	19.7	2.74	*0.010	0.011	45	87	0.256	27.91	w.	1	.....	0	.....	Cloudy	10 alto-stratus.
10:42 a. m..	30.50	33.3	1.69	0.008	0.009	54	74	0.310	27.90	n.	1	10.1	1	0	....do	10 alto-stratus; no shadow.
11:43 a. m..	15.25	39.0	1.48	0.189	0.205	60	59	0.310	27.87	se.	5	5.0	1	2	....do	10 alto-stratus.

* Mean of two readings only; radiation too small to measure after second reading. † Galvanometer defective. ‡ Galvanometer not sufficiently sensitive for accurate work; remedied before next day.

TABLE 9.—*Pyrheliometer observations at Black Mountain, N. C. Latitude, 35° 36′ north; longitude, 82° 19′ west. Elevation above sea level, 2400 feet.*

Date and time (75th meridian time).	Hour angle.	*h.*	*e.*	*Q′.*	*Q.*	*t.*	*R. H.*	*e.*	*B.*	Wind.		*P.*	Sky.	Mt.	Character of sky.	
										Dir.	Vel.				At sun.	In general.
February 19.	°	°				°F.	%	*Inch.*	*Inches.*		*M. p. h.*	%				
9:40 a. m..	45.75	26.8	2.07	0.640	0.696	20	58	0.060	27.99	nw.	8	46.8	9	10	Clear	1 cirrus near sun.
10:33 a. m..	32.50	33.7	1.68	0.662	0.720	22	52	0.057	27.99	nw.	6	48.0	9	9	....do	Few cirrus.
11:36 a. m..	16.75	40.2	1.45	0.790	0.859	27	54	0.077	27.98	n.	6	47.7	9	10	....do	Do.
12:35 p. m..	2.00	42.8	1.37	0.844	0.917	31	53	0.093	27.96	n.	3	47.2	8	10	....do	Few cirrus in north.
2:05 p. m..	20.50	38.2	1.51	0.786	0.854	36	45	0.098	27.90	se.	2	46.7	9	10	....do	2 cirrus near sun.
3:07 p. m..	36.00	31.8	1.76	0.646	0.702	38	42	0.093	27.87	se.	3	40.5	5	10	Cloudy	9 cirrus; very fine.
4:05 p. m..	50.50	23.0	2.36	0.529	0.575	35	52	0.108	27.87	s.	4	43.0	6	10	Partly cloudy.	6 cirrus; very fine.
5:05 p. m..	65.50	12.6	4.16	0.399	0.434	32	51	0.093	27.86	s.	8	44.8	8	10	Clear	No clouds.
5:39 p. m..	74.00	6.3	7.76	0.214	0.233	31	41	0.070	27.86	se.	12	38.0	7	8	....do	Do.
February 20.																
9:10 a. m..	53.25	21.4	2.54	0.648	0.704	34	58	0.113	27.91	n.	20	46.8	9	10	....do	1 fracto-cumulus.
10:35 a. m..	32.00	34.2	1.65	0.819	0.890	36	53	0.113	27.92	n.	15	49.7	9	10	....do	Few cirro-stratus in south.
11:34 a. m..	17.25	40.4	1.44	0.922	1.002	41	44	0.118	27.91	n.	12	49.0	9	10	....do	Do.
12:35 p. m..	2.00	43.1	1.36	0.906	0.985	41	42	0.108	27.90	n.	12	39.3	7	10	....do	9 cirrus near sun.
2:04 p. m..	20.25	39.3	1.47	0.578	0.628	42	41	0.113	27.87	nw.	4	19.6	3	10	Cloudy	1 cirrus; 9 cirro-stratus; solar halo, 22° radius.
3:06 p. m..	35.75	32.2	1.74	0.532	0.578	44	34	0.098	27.83	n.	7	29.7	4	9	....do	10 cirro-stratus; solar halo, 22° radius.
4:05 p. m..	50.50	23.5	2.32	0.269	0.292	43	31	0.085	27.83	nw.	4	19.0	4	9	....do	Do.
5:04 p. m..	65.25	12.9	4.06	0.112	0.122	41	42	0.108	27.83	n.	4	16.0	2	9	....do	Do.
5:43 p. m..	75.00	5.6	8.63	0.005	0.005	34	65	0.124	27.83	nw.	4	16.8	3	7	....do	10 cirro-stratus; no shadow.
February 21.																
9:49 a. m..	43.50	28.1	1.96	0.024	0.026	38	70	0.157	27.77	n.	6	7.0	1	7	....do	10 alto-stratus; shadow with readings 1 and 4.
10:36 a. m..	31.75	34.6	1.63	0.012	0.013	41	57	0.143	27.75	nw.	6	5.5	1	8	....do	10 alto-stratus; no shadow.
12:37 p. m..	1.50	43.5	1.34	0.750	0.815	52	38	0.150	27.70	nw.	15	25.0	3	10	....do	9 cirrus.
2:07 p. m..	21.00	39.3	1.46	0.906	0.985	50	35	0.130	27.65	n.	20	46.8	7	10	Clear	1 cirrus near sun.
3:08 p. m..	36.25	32.4	1.72	0.786	0.854	48	27	0.089	27.64	n.	30	50.6	9	10	....do	Few cirrus.
4:05 p. m..	50.50	23.8	2.27	0.713	0.775	46	36	0.108	27.63	n.	30	49.0	9	10	....do	Do.
5:05 p. m..	65.50	12.7	4.10	0.402	0.437	43	44	0.118	27.64	n.	25	45.2	8	9	....do	No clouds.
5:44 p. m..	75.25	5.6	8.57	0.128	0.139	40	50	0.124	27.65	n.	20	37.4	6	8	....do	No clouds; tree shades sun.
February 23.																
7:41 a. m..	75.50	6.0	8.11	0.234	0.254	18	98	0.089	28.01	sw.	2	37.4	8	10	....do	No clouds.
8:37 a. m..	61.50	16.4	3.28	0.526	0.572	30	79	0.130	28.01	sw.	3	46.3	9	10	....do	Do.
9:36 a. m..	46.75	26.6	2.08	0.694	0.754	36	65	0.143	28.01	sw.	3	47.8	9	10	....do	Do.
10:35 a. m..	32.00	25.3	1.62	0.800	0.870	42	45	0.118	27.99	sw.	4	47.9	9	10	....do	Do.
11:36 a. m..	16.75	41.6	1.41	0.838	0.911	48	29	0.098	27.98	sw.	3	48.5	9	10	....do	Do.
12:35 p. m..	2.00	44.2	1.34	0.904	0.983	53	26	0.108	27.96	sw.	3	48.0	9	10	....do	Do.
2:05 p. m..	20.50	40.3	1.44	0.780	0.848	55	33	0.143	27.91	sw.	3	36.4	8	10	Partly cloudy.	Fine cirrus over most of sky.
5:35 p. m..	73.00	7.4	6.69	0.004	0.004	46	41	0.130	27.85	s.	6	11.4	2	7	Cloudy	10 cirro-stratus; no shadow.
February 24.																
7:44 a. m..	74.75	7.2	6.84	0.160	0.174	22	96	0.103	27.78	nw.	4	33.3	6	9	Clear	No clouds.
8:38 a. m..	61.25	17.0	3.14	0.359	0.390	30	83	0.136	27.78	n.	4	42.2	7	7	Light haze....	Do.
9:36 a. m..	46.75	27.1	2.02	0.564	0.613	39	68	0.164	27.77	nw.	5	43.2	8	7	....do	Do.
10:36 a. m..	31.75	35.9	1.58	0.766	0.833	48	40	0.136	27.76	nw.	10	43.3	8	7	.. do	Do.
12:35 p. m..	2.00	44.6	1.32	0.902	0.980	55	21	0.093	27.73	nw.	20	40.4	8	8	....do	1 cirrus.
2:07 p. m..	21.00	40.6	1.43	0.732	0.796	56	24	0.103	27.69	nw.	15	33.8	6	8	Partly cloudy.	Fine cirrus over most of sky.
3:06 p. m..	35.75	33.8	1.66	0.488	0.530	56	23	0.103	27.67	nw.	15	21.6	4	8	Cloudy	9 cirrus.
4:07 p. m..	51.00	24.0	2.26	0.393	0.427	54	28	0.113	27.67	n.	20	30.8	6	8	....do	Do.
5:35 p. m..	73.00	8.1	6.17	0.011	0.012	48	40	0.130	27.68	n.	20	15.3	2	7	....do	5 cirrus; 5 cirro-stratus; no shadow.
February 25.																
7:48 a. m..	73.75	8.8	5.78	0.172	0.187	23	99	0.118	27.84	w.	3	35.2	6	7	....do	Fine cirrus over most of sky.
9:41 a. m..	45.50	28.1	1.96	0.418	0.454	41	65	0.172	27.87	sw.	2	26.6	3	7	....do	10 cirro-stratus.
10:37 a. m..	31.50	36.2	1.57	0.646	0.702	43	64	0.172	27.87	s.	3	36.4	4	7	....do	5 cirrus; 4 cirro-stratus.
12:35 p. m..	2.00	45.0	1.31	0.485	0.527	47	58	0.187	27.86	s.	10	19.3	3	6	....do	5 cirrus; 5 cirro-stratus; solar halo, 22° radius.
2:06 p. m..	20.75	41.2	1.41	0.420	0.457	49	49	0.172	27.85	se.	10	23.0	3	6	....do	1 cirrus; 8 cirro-stratus; solar halo, 22° radius.
3:05 p. m..	35.50	34.6	1.64	0.259	0.282	49	49	0.172	27.84	se.	12	17.5	3	3	....do	3 cirrus; 7 cirro-stratus; solar halo, 22° radius.
4:07 p. m..	51.00	24.8	2.27	0.035	0.038	48	52	0.180	27.84	se.	12	6.8	1	3	....do	10 cirro-stratus; no shadow.
5:05 p. m..	65.50	14.6	3.63	0.005	0.005	46	49	0.157	27.85	se.	10	7.3	1	3	....do	Do.
5:44 p. m..	75.25	7.2	6.86	0.006	0.007	45	51	0.150	27.86	se.	12	20.0	2	3	....do	Do.
February 26.																
7:46 a. m..	74.00	7.7	6.56	0.142	0.154	28	89	0.130	27.97	s.	4	32.3	7	6	Light haze....	Few cirrus.
8:49 a. m..	58.85	19.8	2.74	0.378	0.411	39	57	0.130	28.00	s.	4	36.8	7	7	Partly cloudy.	Fine cirrus over most of sky.
9:34 a. m..	47.00	27.2	2.04	0.584	0.635	42	53	0.143	28.00	s.	6	38.6	7	7	Light haze....	1 cirrus in south.
10:37 a. m..	31.75	36.6	1.56	0.390	0.424	47	45	0.143	28.00	s.	6	32.0	7	6	Partly cloudy.	1 cirrus; 8 alto-stratus; sun obscured last reading.
12:36 p. m..	1.50	45.4	1.31	0.316	0.343	52	46	0.172	27.99	s.	12	2.9	0	3	....do	10 alto-stratus; sun obscured last two readings.
February 28.																
8:56 a. m..	56.50	21.5	2.47	0.438	0.476	60	72	0.373	27.22	sw.	18	30.2	8	9	Partly cloudy.	2 cirrus; 1 alto-cumulus; 2 cumulo-stratus.
9:35 a. m..	46.75	28.4	1.90	0.704	0.765	63	48	0.277	27.22	sw.	18	10.8	2	9	....do	4 alto-stratus; 4 alto-cumulus; 1 cumulo-stratus.
10:37 a. m..	31.25	37.1	1.51	0.012	0.013	60	44	0.219	27.26	sw.	20	6.5	1	9	Cloudy	10 cumulo-stratus; no shadow after 1st reading.
12:39 p. m..	0.75	46.2	1.27	0.292	0.317	60	40	0.211	27.29	sw.	24	16.9	2	10	....do	1 cirrus; 8 cirro-stratus; solar halo, 22° radius.
2:06 p. m..	21.00	42.2	1.36	0.194	0.211	60	43	0.219	27.29	nw.	5	6.4	1	9	....do	10 alto-stratus; no shadow last reading.
3:11 p. m..	37.25	34.4	1.61	0.390	0.424	60	37	0.187	27.30	sw.	15	18.4	4	9	Partly cloudy.	9 cirrus.
4:04 p. m..	50.50	25.9	2.08	0.618	0.672	58	45	0.219	27.32	nw.	10	23.6	7	8	....do	5 cirrus; 3 cirro-stratus; 1 cirro-cumulus.
March 2.																
8:56 a. m..	56.50	21.8	2.49	0.242	0.263	32	67	0.118	27.89	se.	3	35.2	7	9	....do	1 cirrus; 8 cirro-stratus.
9:33 a. m..	47.25	18.2	1.96	0.003	0.003	33	70	0.124	27.89	s.	3	15.6	1	8	Cloudy	5 cirro-stratus; 5 alto-stratus.
10:37 a. m..	31.25	38.0	1.51	0.476	0.517	41	55	0.136	27.89	s.	2	25.6	4	8	Partly cloudy.	9 cirro-stratus; 1 alto-cumulus.
11:37 a. m..	16.25	44.3	1.33	0.127	0.138	41	64	0.164	27.89	s.	4	4.4	0	6	Cloudy	1 alto-cumulus; 9 alto-stratus.
12:33 p. m..	2.25	46.9	1.28	0.128	0.139	42	64	0.172	27.88	sw.	4	2.4	0	6	Partly cloudy.	4 alto-cumulus; 4 alto-stratus; shadow with 4th reading.
March 3.																
7:30 a. m..	78.00	6.0	8.09	0.188	0.204	26	90	0.124	27.94	calm.	.....	42.2	8	8	Clear	Few cirrus in northwest.
8:35 a. m..	61.75	18.4	2.93	0.464	0.504	36	80	0.164	27.95	sw.	3	45.8	8	8	....do	1 alto-cumulus in north.
9:34 a. m..	47.00	28.9	1.92	0.724	0.787	44	66	0.187	27.95	sw.	3	46.8	8	7	Light haze....	Do.
10:36 a. m..	31.50	38.3	1.50	0.814	0.885	50	52	0.187	27.94	sw.	4	47.4	8	8	....do	Few alto-cumulus in northeast.
12:34 p. m..	2.00	47.3	1.27	0.814	0.885	52	48	0.187	27.92	s.	7	47.2	8	7	... do	No clouds.
2:07 p. m..	21.25	42.8	1.37	0.772	0.839	53	45	0.180	27.89	s.	7	46.1	8	6	....do	Do.
3:04 p. m..	35.50	35.9	1.58	0.723	0.786	53	43	0.172	27.89	s.	10	45.4	8	6	....do	Few cirrus in west.
4:05 p. m..	50.75	26.3	2.09	0.566	0.615	53	45	0.180	27.88	s.	10	43.6	8	7	....do	1 cirrus.
5:17 p. m..	68.78	13.0	4.04	0.204	0.222	52	58	0.228	27.89	se.	7	20.1	3	5	....do	Few cirrus; 1 alto-stratus.
March 5.																
8:45 a. m..	59.00	20.7	2.60	0.644	0.700	54	80	0.334	27.73	sw.	4	31.0	6	8	....do	1 cirrus; 2 cirro-stratus; few cumulo-stratus.
9:33 a. m..	47.00	29.3	1.88	0.292	0.317	56	77	0.334	27.73	nw.	2	3.2	1	6	Cloudy	4 cirro-stratus; 6 cumulo-stratus; solar halo, 22° radius.
10:33 a. m..	32.00	38.4	1.49	0.050	0.054	60	70	0.360	27.73	nw.	6	2.8	0	8	....do	6 alto-stratus; 4 alto-cumulus; no shadow.
12:28 p. m..	3.25	47.9	1.25	0.004	0.004	63	66	0.373	27.72	nw.	4	2.0	0	8	....do	9 alto-stratus; 1 cumulo-stratus; sun not visible.
March 6.																
9:21 a. m..	50.00	27.8	1.98	0.348	0.378	56	89	0.402	27.76	nw.	2	11.6	1	6	Partly cloudy.	9 cumulo-stratus.
10:34 a. m..	31.75	39.1	1.47	0.275	0.299	61	78	0.417	27.77	sw.	4	4.8	1	7	Cloudy	3 alto-stratus; 7 cumulo-stratus.
12:33 p. m..	2.00	48.4	1.24	0.176	0.191	62	77	0.432	27.74	sw.	4	3.4	0	7	....do	9 cirro-stratus; 1 cumulo-stratus; solar halo, 22° radius.
2:04 p. m..	20.75	44.0	1.33	0.077	0.084	62	77	0.432	27.71	e.	9	2.6	0	7	....do	Do.
3:00 p. m..	34.75	38.0	1.50	0.000	0.000	62	77	0.432	27.70	e.	7	.....	0	7	....do	10 cumulo-stratus; sun not visible.
March 9.																
9:00 a. m..	55.00	24.9	2.19	0.018	0.020	59	88	0.448	27.79	sw.	4	34.4	7	5	....do	1 cirrus; 6 alto-cumulus; no shadow.
10:51 a. m..	27.25	42.2	1.38	0.064	0.070	66	65	0.417	27.78	s.	7	3.8	1	6	....do	8 alto-stratus; 2 cumulus; shadow 1st reading.
11:33 a. m..	16.75	46.7	1.27	0.964	1.048	72	68	0.499	27.78	se.	6	4.8	0	7	Clear	1 cirrus; 4 alto-stratus; 3 cumulus.

TABLE 9.—*Pyrheliometer observations at Black Mountain, N. C.*—Continued.

Date and time (75th meridian time).	Hour angle.	*h.*	*e.*	*Q'.*	*Q.*	*t.*	*R. H.*	*e.*	*B.*	Wind.		*P.*	Sky.	Mt.	Character of sky.	
										Dir.	Vel.				At sun.	In general.
Mar. 9—*Cont'd.*	°	°				°F.	%	*Inch.*	*Inches.*		*M. p. h.*	%				
12:38 p. m..	0.50	49.6	1.22	0.001	0.001	68	68	0.448	27.77	s.	10	.....	0	7	Cloudy	1 alto-stratus; 9 cumulo-stratus; sun not visible after 1st reading.
2:06 p. m..	21.50	44.9	1.32	0.506	0.550	67	76	0.499	27.74	s.	6	3.5	0	7	....do	1 cirrus; 2 alto-stratus; 7 cumulus.
3:11 p. m..	37.75	36.5	1.56	0.023	0.025	67	75	0.482	27.72	s.	6	3.0	0	7	....do	9 alto-stratus; 1 cumulus.
March 12.																
11:05 a. m..	23.50	44.8	1.32	0.142	0.154	57	91	0.432	27.77	se.	10	0.8	0	0	....do	10 stratus; light rain; shadow with 2d and 3d reading.
2:06 p. m..	21.75	45.9	1.29	0.330	0.359	57	88	0.417	27.71	se.	10	1.2	0	0	....do	10 stratus; no shadow last reading.
3:11 p. m..	38.00	26.9	1.54	0.001	0.001	56	89	0.417	27.71	se.	9	1.0	0	0	....do	10 stratus; sun not visible after 1st reading.
March 13.																
10:49 a. m..	27.50	43.6	1.34	0.004	0.004	54	86	0.360	27.73	e.	3	2.6	0	0	....do	10 stratus; no shadow.
11:35 a. m..	16.00	48.6	1.23	0.016	0.017	54	84	0.347	27.71	e.	4	0.2	0	0	....do	Do.
12:31 p. m..	2.00	51.1	1.19	0.002	0.002	54	87	0.360	27.70	se.	7	1.2	0	0	....do	10 stratus; sun not visible after 1st reading.
March 17.																
11:52 a. m..	11.50	51.4	1.19	0.023	0.025	61	73	0.402	27.76	s.	2	5.8	1	3	....do	9 alto-cumulus; 1 cumulo-stratus; no shadow.
1:59 p. m..	20.25	48.4	1.24	0.005	0.005	62	67	0.373	27.71	se.	9	0.8	0	3	....do	5 alto-cumulus; 5 cumulo-stratus; no shadow.
5:48 p. m..	77.50	9.3	5.49	0.304	0.330	60	78	0.402	27.67	se.	7	36.1	5	4	Light haze....	5 alto-cumulus; 1 cumulo-stratus.
March 18.																
7:11 a. m..	81.75	6.0	8.05	0.115	0.125	42	98	0.256	27.78	nw.	1	35.9	7	4	Light fog	No clouds.
8:31 a. m..	61.75	21.9	2.47	0.584	0.635	57	83	0.387	27.79	sw.	4	44.8	8	7	Light haze....	Few fracto-cumulus in south.
9:32 a. m..	46.50	33.1	1.69	0.706	0.767	61	74	0.402	27.79	sw.	4	44.2	8	8	....do	Few cumulus.
10:34 a. m..	31.00	42.4	1.37	0.879	0.946	62	68	0.373	27.79	s.	12	38.0	8	8	....do	3 cumulus.
11:33 a. m..	16.25	49.8	1.22	0.100	0.109	63	69	0.402	27.79	e.	7	10.6	8	7	Cloudy	9 cumulo-stratus; shadow with 3d reading.
2:01 p. m..	20.75	48.4	1.24	0.534	0.580	65	65	0.417	27.77	ne.	7	11.8	5	6	Partly cloudy.	9 cumulo-stratus; no shadow with 4th reading.
3:33 p. m..	43.75	31.4	1.77	0.735	0.799	66	60	0.387	27.76	se.	7	15.2	9	6	....do	9 cumulo-stratus; few cirrus.
5:23 p. m..	71.25	14.0	3.53	0.374	0.407	65	61	0.387	27.76	se.	10	33.0	9	4	Light haze....	5 cumulo-stratus.
March 23.																
9:32 a. m..	46.00	34.2	1.62	0.263	0.286	57	84	0.387	27.36	e.	4	6.4	1	8	Partly cloudy.	1 cirrus; 1 alto-cumulus; 6 cumulo-stratus.
10:32 a. m..	31.00	44.8	1.30	0.926	1.007	62	72	0.387	27.37	e.	3	41.2	8	10	Clear	1 cumulus.
11:31 a. m..	16.25	51.8	1.16	0.988	1.074	63	70	0.402	27.38	ne.	3	40.6	8	10	....do	Do.
12:32 p. m..	1.00	55.1	1.12	0.986	1.072	66	55	0.347	27.37	s.	5	43.4	8	10	....do	Do.
2:14 p. m..	24.50	48.3	1.23	0.529	0.575	68	54	0.360	27.37	sw.	3	37.9	9	10	Partly cloudy.	6 cumulus.
3:02 p. m..	36.50	41.2	1.39	0.925	1.005	68	61	0.417	27.37	se.	5	5.2	0	9	Clear	Few cirrus; 6 cumulus.
4:03 p. m..	51.75	30.5	1.79	0.864	0.939	69	56	0.402	27.38	nw.	10	40.0	8	8	....do	Few cirrus; 4 cumulus.
5:00 p. m..	66.00	19.9	2.67	0.682	0.741	68	58	0.402	27.39	nw.	9	8.7	8	8	....do	6 cumulus.
6:01 p. m..	81.25	7.6	6.51	0.306	0.333	65	57	0.347	27.41	nw.	10	40.7	8	7	....do	1 cumulus.
March 24.																
7:02 a. m..	83.50	6.5	7.48	0.026	0.028	43	93	0.256	27.59	n.	20	12.4	1	8	Cloudy	8 cirrus; 1 alto-stratus; shadow with 3d and 4th readings.
8:35 a. m..	60.25	24.8	2.19	0.124	0.135	48	78	0.256	27.60	n.	20	38.3	7	10	....do	7 cirrus.
March 25.																
7:38 a. m..	74.50	14.0	3.75	0.301	0.327	36	51	0.103	27.69	nw.	24	23.2	3	10	Partly cloudy.	9 cirro-stratus; few fracto-cumulus.
8:44 a. m..	58.00	27.2	2.02	0.672	0.730	39	40	0.098	27.70	nw.	24	39.0	6	10	Clear	7 cirrus.
9:37 a. m..	44.75	37.1	1.54	0.788	0.857	40	33	0.081	27.70	nw.	20	45.2	8	10	....do	1 cirrus; near sun.
10:36 a. m..	30.00	46.7	1.27	0.886	0.963	42	43	0.113	27.70	nw.	20	44.8	8	10	....do	Few cirrus in south.
11:33 a. m..	15.75	53.6	1.15	0.908	0.987	45	36	0.108	27.71	nw.	15	43.2	8	10	....do	Few cirrus in southeast.
12:36 p. m..	0.00	56.0	1.12	0.877	0.953	48	35	0.118	27.72	nw.	20	43.5	8	10	....do	No clouds.
2:04 p. m..	22.00	50.4	1.20	0.887	0.964	51	34	0.130	27.70	nw.	15	43.6	8	10	....do	Do.
5:03 p. m..	66.75	19.9	2.69	0.488	0.530	48	44	0.150	27.68	nw.	13	42.2	8	9	....do	Do.
6:04 p. m..	82.00	7.9	6.32	0.196	0.213	46	52	0.164	27.70	nw.	12	32.8	7	8	....do	Do.
March 26.																
7:09 a. m..	81.50	8.3	6.08	0.272	0.296	28	93	0.136	27.83	n.	3	40.6	8	10	....do	Do.
8:35 a. m..	60.00	25.5	2.15	0.658	0.715	42	65	0.172	27.85	n.	1	47.0	8	10	....do	Do.
10:35 a. m..	30.00	46.6	1.28	0.858	0.933	52	45	0.172	27.84	nw.	4	47.2	8	10	....do	Do.
12:33 p. m..	0.50	56.3	1.12	1.017	1.105	58	37	0.180	27.82	sw.	4	47.1	8	9	....do	Do.

only object in making a separate entry under this subheading is to indicate whether clouds that could possibly affect the observed radiation covered the sun or not.

Tables 10 and 11 give monthly averages of those pyrheliometer and polarization observations that were taken with a cloudless sky, and of all the observations of relative and absolute humidity, taken at Asheville and Black Mountain, N. C., respectively. The average time at which the pyrheliometer observations were taken is stated at the head of each column.

It will be seen that the radiation was at a maximum in November, and at a minimum in January, and that the observations during the middle of the day at Black Mountain averaged but little higher than those at Asheville for the same hours during the first half of February, although the former were

TABLE 10.—*Monthly averages at Asheville, N. C.*

RADIATION FROM SUN, IN CALORIES (*Q*).

Year and month.	9:10 a. m.	9:40 a. m.	10:50 a. m.	11:38 a. m.	12:37 p. m.	1:37 p. m.	3:06 p. m.	4:06 p. m.	4:30 p. m.	5:02 p. m.	5:41 p. m.
1902.											
Nov.....	.....	0.891	1.003	1.091	1.093	1.067	0.947	0.729	0.523	.....	.....
Dec.....	0.654	0.746	0.858	0.882	0.948	0.877	0.789	0.549	0.363	.....	.....
1903.											
Jan.....	0.495	0.607	0.780	0.846	0.832	0.837	0.685	0.508	0.350	0.229	0.153
Feb.....	0.388	0.661	0.697	0.866	0.985	0.991	0.935	0.725	.....	0.489	0.120

PERCENTAGE OF POLARIZATION OF SKY LIGHT (*P*).

1902.											
Dec.....	55.2	51.2	50.8	49.8	49.6	49.9	50.0	47.7	40.6	.....	.....
1903.											
Jan.....	45.5	46.5	46.7	46.7	43.6	45.8	43.1	40.8	38.1	.....	.....
Feb.....	.....	44.2	44.6	46.0	47.1	47.2	47.2	47.2	.....	43.2	42.6

PERCENTAGE OF RELATIVE HUMIDITY OF THE AIR.

Year and month.	9:10 a. m.	9:40 a. m.	10:50 a. m.	11:38 a. m.	12:37 p. m.	1:37 p. m.	3:06 p. m.	4:06 p. m.	4:30 p. m.	5:02 p. m.	5:41 p. m.
1902.											
Nov.....	81	73	66	59	52	50	48	50	57	.....	.....
Dec.....	66	58	50	48	46	40	44	46	50	.....	.....
1903.											
Jan.....	72	68	59	57	55	54	50	48	47	.....	.....
Feb.....	.....	76	63	56	50	44	38	39	.....	37	40

VAPOR TENSION, OR ABSOLUTE HUMIDITY, IN INCHES.

1902.											
Nov.....	0.249	0.257	0.319	0.322	0.309	0.403	0.305	0.309	0.310	.....	.....
Dec.....	0.110	0.129	0.129	0.146	0.143	0.148	0.165	0.162	0.163	.....	.....
1903.											
Jan.....	0.131	0.128	0.131	0.159	0.146	0.149	0.139	0.133	0.124	.....	.....
Feb.....	.....	0.196	0.185	0.205	0.176	0.160	0.157	0.160	.....	0.148	0.160

TABLE 11.—*Averages at Black Mountain, N. C., February 19 to March 26.*

	7:30 a. m.	8:38 a. m.	9:32 a. m.	10:35 a. m.	11:34 a. m.	12:34 p. m.	2:06 p. m.	3:05 p. m.	4:04 p. m.	5:10 p. m.	5:54 p. m.
Radiation..... ...	0.200	0.607	0.726	0.893	0.980	0.986	0.911	0.837	0.776	0.473	0.272
Polarization	37.6	44.2	46.0	46.2	45.8	45.3	45.8	48.0	44.2	43.7	35.1
Relative humidity .	90	73	65	65	62	52	52	51	43	51	53
Vaper Tension	0.146	0.229	0.210	0.210	0.277	0.220	0.252	0.254	0.174	0.205	0.182

taken at about 200 feet greater elevation, through a clearer atmosphere, and with the sun some 10 degrees higher at noon than were the latter.

The deficiency in the value of Q for January, February, and March, 1903, as compared with the average values for these months during previous years, has been noticed by M. Henri Dufour,[6] at Lausanne, Switzerland, who is inclined to attribute it to increased absorption and reflection of radiation by the atmosphere, due to the presence of volcanic dust. In a letter dated July 9, 1903, the Acting Secretary of the Smithsonian Institution says:

> The observations made here [the astrophysical observatory at Washington] indicate that the drop in the actinometric readings of which you speak is chiefly caused by the increased absorption of the earth's atmosphere during the present calendar year.

The investigation of the cause of this apparent decrease in the amount of solar radiation received at the surface of the earth calls for a special study of the absorption of the atmosphere. While it is difficult to distinguish between cause and effect in this case, it would seem that the general atmospheric conditions suffice to explain the decrease in the value of Q in the observations here presented. During November and the first part of December there were periods of several days of almost cloudless sky. After the middle of December there were few good days until February, and March was almost continuously cloudy until the 23d. When conditions were such that clouds formed readily, particularly in the upper levels, the radiation was small even although clouds might not be visible near the sun. That the radiation is influenced to a greater degree by such conditions than by the surface relative or absolute humidity is easily perceived by an examination of Tables 10 and 11.

It is worthy of note that the polarization of sky light fell off after December, but the relation between radiation and polarization appears to be so complicated that its consideration may well be postponed until more observations have been accumulated. The decrease in the polarization may have been partly due to the fact that as the altitude of the sun above the southern horizon increased from day to day, so the point at which the polarization was measured constantly fell nearer the northern horizon.

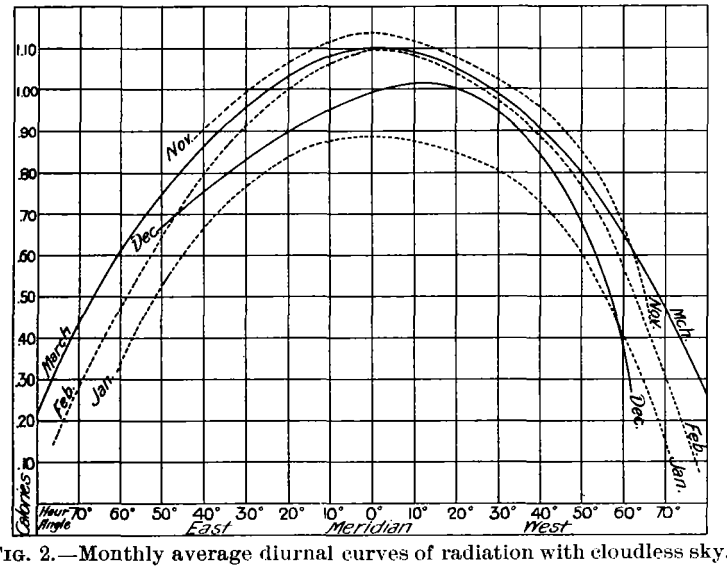

FIG. 2.—Monthly average diurnal curves of radiation with cloudless sky.

The free-hand curves in fig. 2 have been constructed by plotting the pyrheliometer observations taken under the most favorable conditions, with hour angle for abscissas and Q, in calories, for ordinates. They show graphically the same peculiarities in the monthly averages that are seen in Tables 10 and 11.

[6] Paris, Comptes Rendus, March 16, 1903, CXXXVI, pp. 713-715.

In fig. 3 the observations for each station taken under the most favorable conditions have been plotted with the length of path through the atmosphere, or ε, for abscissas and Q for ordinates. In fig. 4 observations for some of the best days have been similarly treated. The curves in both figures show that at Asheville, for equal length of paths through the atmosphere, less radiation was received during the morning than during the afternoon, while at Black Mountain the difference was very slight. No doubt the smoky condition of the atmosphere at Asheville was responsible for the deficiency in the morning radiation. After the lower layers became sufficiently heated to establish convection currents the smoke was carried away, even when the surface wind was light, and the atmosphere was thus made comparatively clear in the afternoon.

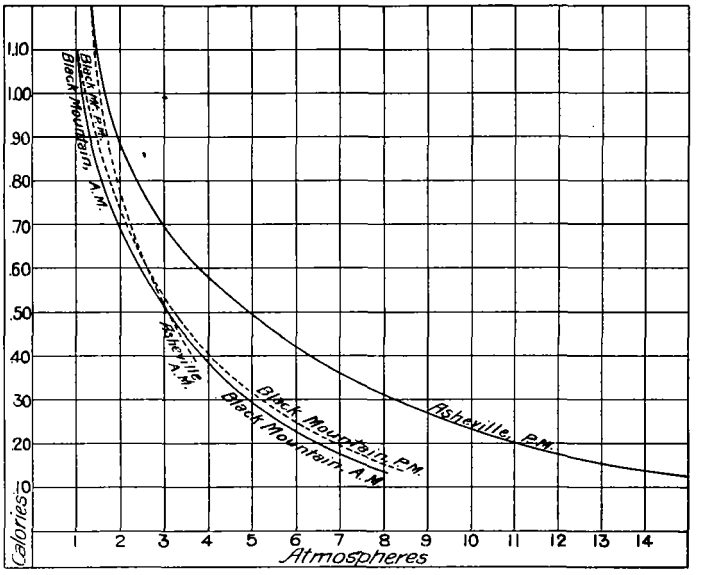

FIG. 3.—Average variation of radiation with ε.

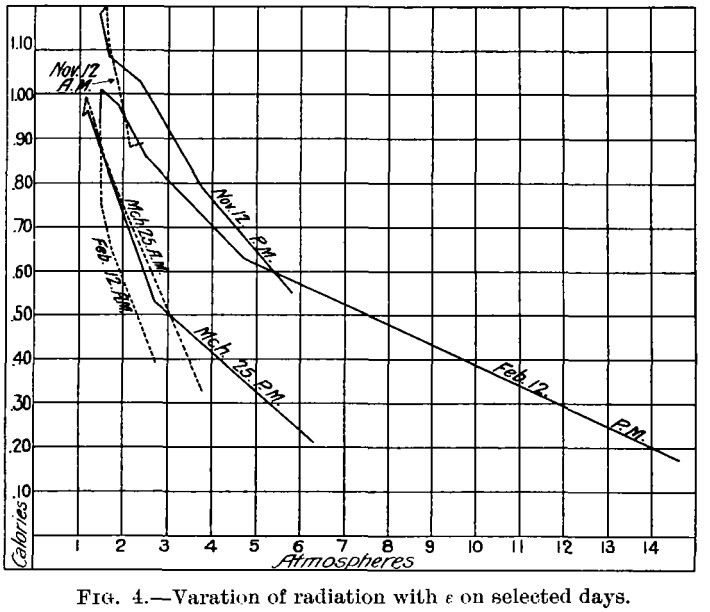

FIG. 4.—Varation of radiation with ε on selected days.

In figs. 5 and 6 are shown characteristic diurnal curves of radiation for different conditions of the sky. November 10, 11, 12, and 13 were quite clear, except that dense haze was recorded on the morning of the 11th and dense smoke on the morning of the 13th. Under these conditions the radiations were depressed to a marked extent, causing wide divergence between the curves for the different dates during the morning

TABLE 12.—*Percentage of polarization of sky light after sunset.*

Date.	Time after sunset (minutes).						Remarks.
	0.	10.	15.	20.	27.	30.	
1902.	%	%	%	%	%	%	
December 11 ...	35.7	51.9	.....	59.6	.....	68.7	Sun set behind clouds; many cirrus observed.
December 13 ...	39.9	53.9	.....	66.2	.....	69.2	Fine cirrus over most of sky.
December 16 ...	45.2	52.0	55.1	56.6	.....	58.8	Clear.
December 17 ...	39.4	50.6	.....	62.3	.....	64.0	Light smoke.
December 18 ...	36.3	44.2	.....	57.0	..	61.1	Light smoke.
December 23 ...	34.8	41.3	.....	59.4	.....	54.2	Few fracto-cumulus; light haze and smoke.
December 31 ...	37.0	54.1	.....	61.7	.....	64.8	Light haze and smoke.
1903.							
January 6.....	28.5	46.8	.....	57.8	57.2	.....	Cirro-stratus on western horizon.
January 8.....	30.3	42.5	.....	42.1	.....	.....	Cumulo-stratus increased; too dark for later observations.
January 9.....	40.5	54.9	.....	51.5	.....	54.8	Few cirrus; light smoke.
January 12.....	35.1	55.8	.....	59.9	.....	57.1	Brilliant sunset.
January 13.....	36.6	57.8	.....	64.0	.....	67.9	Few cirrus.
January 15.....	34.6	54.6	.....	66.5	.....	67.8	Light smoke.
January 19.....	39.0	56.0	.....	64.5	65.5	.....	Do.
January 22.....	33.9	53.9	.....	64.8	63.2	.....	Few cirrus; light smoke.
January 23.....	39.5	57.7	.....	59.8	56.5	.....	Do.
January 30.....	31.5	57.2	.....	63.9	60.8	.....	Few cirrus; brilliant sunset.
February 4 ...	37.5	58.5	.....	50.5	51.1	.....	Few alto-stratus.
February 5 ...	36.4	55.6	.....	55.1	60.3	.....	9 cirro-stratus; light smoke.
February 9 ...	28.2	49.0	.....	64.4	.....	.....	Few alto-stratus; brilliant sunset.
February 13 ...	47.9	58.9	.....	46.4	54.9	.....	

hours as compared with close agreement during the afternoon hours.

February 12 and 13 were apparently about equally clear, but the radiation curves present marked contrasts, that for the 12th indicating that the atmosphere was clearing throughout the day.

The curves for January 19 and March 3 and 25 are very much flattened during the middle of the day without apparent cause.

On February 25 the sky was overcast all day with cirrus and cirro-stratus clouds, which became so dense that no shadows were cast by sunlight after 4 p. m. A solar halo was observed from 12:30 p. m. to 3:00 p. m.

These results indicate the marked variations in the quantity of heat that is received at the surface of the earth from the sun from day to day, but the observations will no doubt prove of especial value, in conjunction with those made in other parts of the world, for the study of widespread periodic fluctuations

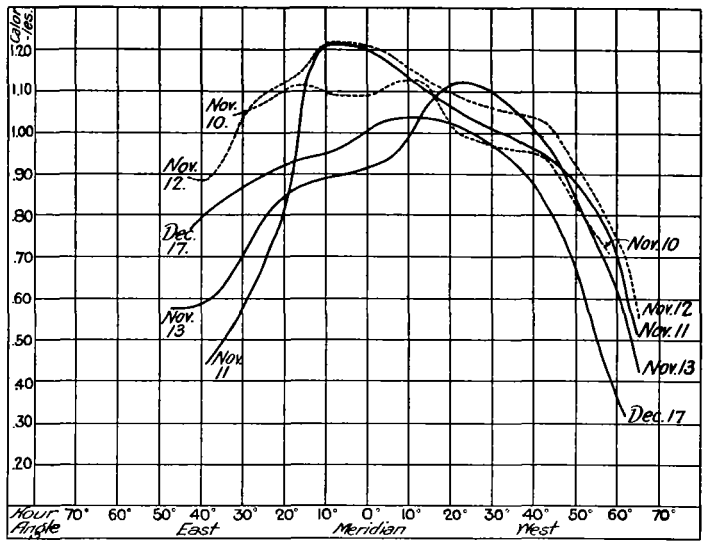

FIG. 5.—Diurnal curves of radiation on selected days.

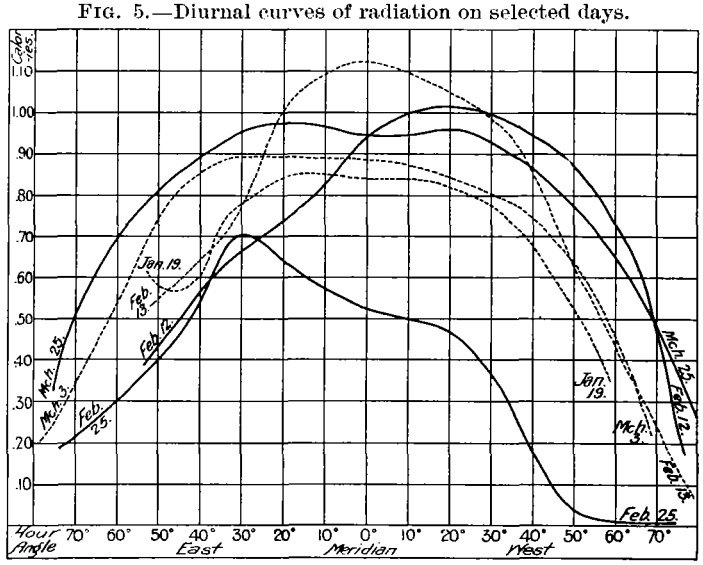

FIG. 6.—Diurnal curves of radiation on selected days.

TABLE 13.—*Percentage of polarization of sky light at points at different distances from sun.*

On vertical circle through sun.

January 6.				January 8.				January 10.				March 25.			
Sun's—		Distances of observed point from sun.	P.	Sun's—		Distances of observed point from sun.	P.	Sun's—		Distances of observed point from sun.	P.	Sun's—		Distances of observed point from sun.	P.
Azimuth.	Altitude.			Azimuth.	Altitude.			Azimuth.	Altitude.			Azimuth.	Altitude.		
°	°	°	Per cent.	°	°	°	Per cent.	°	°	°	Per cent.	°	°	°	Per cent.
58.5	0	168.0	— 4.9	.....	.....	.....	.....	51.0	11.0	163.0	— 3.0	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	52.5	8.8	162.7	— 4.0	.....	.....	.....	.....
58.5	0	155.8	— 0.4	59.0	0	154.4	+ 1.9	51.0	11.0	149.0	+ 0.5	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	51.0	9.0	147.0	+ 7.7	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	52.5	8.8	147.7	± 0.0	.....	.....	.....	.....
60.0	—2	130.0	23.0	.....	.....	.....	.....	50.6	11.0	130.0	+11.4	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	329.1	53.9	116.1	33.6
60.1	—2	110.0	46.8	.....	.....	.....	.....	49.5	11.3	110.0	27.4	329.1	53.9	106.1	40.1
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	327.1	53.1	96.9	43.0
60.1	—2	90.0	47.5	.....	.....	.....	.....	.....	.....	.....	.....	316.0	49.0	90.0	44.8
61.7	—3	90.0	57.8	37.9	20.7	90.0	37.8	48.1	13.0	90.0	41.0	317.1	53.1	86.9	42.0
.....	.....	.....	.....	43.0	17.1	80.0	35.4	.....	.....	.....	.....	325.9	52.6	77.4	36.8
.....	.....	.....	.....	42.1	18.1	70.0	25.5	49.5	11.3	70.0	23.1	325.9	52.6	67.4	27.3
.....	.....	.....	.....	41.2	18.4	60.0	17.2	.....	.....	.....	.....	324.0	52.1	57.9	17.4
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	324.0	52.1	47.9	9.8
.....	.....	.....	.....	40.2	19.0	40.0	5.0	.....	.....	.....	.....	322.3	51.7	38.3	4.0
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	322.3	51.7	28.3	+2.1
.....	.....	.....	.....	39.6	19.2	18.8	0.1	.....	.....	.....	.....	320.9	50.8	19.2	—0.9
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	320.9	50.8	9.2	+0.3
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	317.5	49.8	— 9.8	—0.8
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	317.5	49.8	—19.8	+0.4
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	319.0	50.2	—30.2	+1.1
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	319.0	50.2	—40.2	+5.9

of this character and their relations to weather changes. A long series of such observations should also be of value in connection with the study of the effect of weather conditions upon crop growth. The results thus far obtained are therefore published at this time without further discussion.

The observations on the polarization of sky light after sunset in Table 12, and on the polarization at different distances from the sun, in Tables 13 and 14 are still to be added. In general, it was found that when the sunset colors were brilliant and extended to the zenith the polarization was less than on evenings when the colors were not so pronounced.

Since the Pickering polarimeter is not well adapted to measuring the polarization when at a minimum, the position of the neutral points of Arago, Brewster, and Babinet could not be accurately determined. The observations of January 6 and 8 indicate that the position of Arago's neutral point was about 25° above the antisolar point, while those of January 10 indicate that it was about 30° above, but these observations in connection with those of February 24 and March 3 and 25 indicate the presence of neutral belts rather than of neutral points.

TABLE 14.—*Percentage of polarization of sky light at points at different distances from sun.*

On horizontal circle passing through sun.				On horizontal circle passing through point of maximum polarization.			
February 24.				March 3.			
Sun's—		Azimuth from sun.	P.	Sun's—		Azimuth from sun.	P.
Azimuth.	Altitude.			Azimuth.	Altitude.		
°	°	°	*Per cent.*	°	°	°	*Per cent.*
.....	.....	.....	.....	307.1	30.9	0	+ 1.6
310.0	30.2	20	+ 1.5	307.1	30.9	20	+ 2.0
310.0	30.2	40	− 1.7	309.1	32.0	40	± 0.0
311.0	30.7	60	−12.0	309.1	32.0	60	− 1.0
311.0	30.7	80	−19.5	312.0	33.2	80	−17.4
312.9	32.1	100	−22.1	312.0	33.2	100	−18.3
312.9	32.1	120	−11.5	313.7	34.5	120	− 6.4
314.4	33.0	140	+ 9.5	313.7	34.5	140	+13.4
314.4	33.0	160	+24.0	314.5	35.8	160	+40.5
316.0	34.0	180	+34.0	314.5	35.8	180	+45.9
316.0	34.0	200	+30.3	322.6	39.8	200	+42.1
325.0	38.2	220	+26.5	322.6	39.8	220	+25.9
325.0	38.2	240	+ 4.4	325.1	40.3	240	+ 4.9
326.9	39.0	260	− 8.8	325.1	40.3	260	− 7.5
326.9	39.0	280	−12.6	327.3	41.0	280	−12.2
328.3	39.5	300	− 8.9	327.3	41.0	300	− 8.0
328.3	39.5	320	− 5.2	328.2	41.7	320	− 1.9
330.1	40.0	340	− 2.0	328.2	41.7	340	+ 0.9
Maximum polarization.....			43.3	.....	.....	.....	.....

CLIMATOLOGICAL DATA FOR JAMAICA.

Through the kindness of Mr. H. H. Cousins, chemist to the government of Jamaica and now in charge of the meteorological service of that Island, we have received the following table in advance of the regular monthly weather report for Jamaica:

Comparative table of rainfall for July, 1903.

Divisions.	Relative area.	Number of stations.	Rainfall.	
			1903.	Average.
	Per cent.		*Inches.*	*Inches.*
Northeastern division	25	24	4.42	8.19
Northern division	22	53	2.20	3.23
West-central division	26	26	7.79	8.19
Southern division	27	36	2.78	4.36
Means	100	139	4.30	5.99

The rainfall for July was therefore below the average for the whole Island. The heaviest fall was 18.08 inches at Kings Valley in the west-central division; while no rain fell at Irish Town in the northeastern division or at Richmond Pen in the northern division.

RECENT PAPERS BEARING ON METEOROLOGY.

Dr. W. F. R. PHILLIPS, Librarian, etc.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——.

Science. New York. N. S. Vol. 18.

Ward, R. DeC. The Climate of Benguet, Philippine Islands. [Note.] Pp. 90–91.

Ward, R. DeC. The Recent Floods. [Note.] P. 91.

Ward, R. DeC. Rainfall and Sunspots. [Review of article by W. J. S. Lockyer.] Pp. 91–92.

Rotch, A. Lawrence. Meteorological Observations with Kites at Sea. Pp. 113–114.

Ward, R. DeC. Climate and Crops in the Argentine Republic. [Review of article by J. Russell Smith.] Pp. 154–155.

Ward, R. DeC. Kite-flying in Scotland and the Cyclone Theory. [Note on article by W. H. Dines.] P. 155.

Ward, R. DeC. Carbon Dioxide in London Railway Carriages. [Note.] P. 155.

Ward, R. DeC. Health on the Isthmus of Panama. [Review of article by Henry L. Abbot.] P. 185.

Scientific American Supplement. New York. Vol. 56.

Guarini, Emile. A Method for the Study of Storms. P. 23065.

Nature. London. Vol. 68.

Wilson, W. E. Radium and Solar Energy. P. 222.

Thorpe, T. E. "Red Rain" and the Dust Storm of February 22. Pp. 222–223.

Marshall, P. Dust Storms in New Zealand. P. 223.

Shaw, W. N. The Thunderstorm of May 31. P. 247.

Lockyer, William, J. S. On a Probable Relationship between the Solar prominences and Corona. Pp. 257–259.

Lagrange, Ch. The Source of Radium Energy. P. 269.

Lockyer, William J. S. A Multiple Lightning Flash. P. 270.

Bianco, Ottavio Zanotti. The Moon's Phases and Thunderstorms. P. 296.

Boys, C. V. The Passage of Sound through the Atmosphere. Pp. 145–150.

Quarterly Journal of the Royal Meteorological Society. London. Vol. 29.

Brodie, Frederick J. The Prevalence of Gales on the Coasts of the British Islands during the 30 years 1871–1900. Pp. 151–171.

Dines, W. H. Formation of Cumulus Cloud. [Reprint from Symons's Meteorological Magazine.] P. 179.

—— Shrinkage of the Thames and Lea. [Review of Report by Mr. Fitzmaurice.] Pp. 179–180.